TM 5-6600

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

ALIDADE MINATURE TELESCOPIC

KEUFFEL AND ESSER MODELS 5093A, 5187A 5095A, 5189A, P5093A AND P5095A

DEPARTMENT OF THE ARMY • *FEBRUARY 1957*

TECHNICAL MANUAL
No. 5–6600

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *26 February 1957*

ALIDADE, MINIATURE, TELESCOPIC, KEUFFEL AND ESSER MODELS 5093A, 5187A, 5095A, 5189A, P5093A, AND P5095A

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CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual is published for the use of the personnel to whom these alidades are issued. It contains information on the operation and organizational maintenance of the alidades as well as a description of the major units and their functions in relation to other components of the unit. It applies only to the Keuffel and Esser alidade, model P5095A, 5095A, 5189A, P5093A, 5093A, and 5187A. Information on the principles of surveying is published in TM 5–232 and TM 5–233.

b. Any errors, or suggestions for improvement of this manual, should be brought to the attention of theCommanding General, The Engineer Maintenance Center Corps of Engineers, U. S. Army, P. O. Box 119, Columbus 16, Ohio: Attention: ENGJX. Direct communciation is authorized.

2. Record and Report Forms

The following record and report forms are used in the operation and maintenance of surveying instruments. Copies of DA Form 285 must accompany field parties at all times to facilitate the reporting of accidents.

a. DA Form 5–14 (Annual Technical Inspection Report of Engineering Equipment).

b. DA Form 9–81 (Exchange Part of Unit Identification Tag).

c. DA Form 285 (Accident Report of Personal or Property Damage).

d. DD Form 447 (Turn-in Slip).

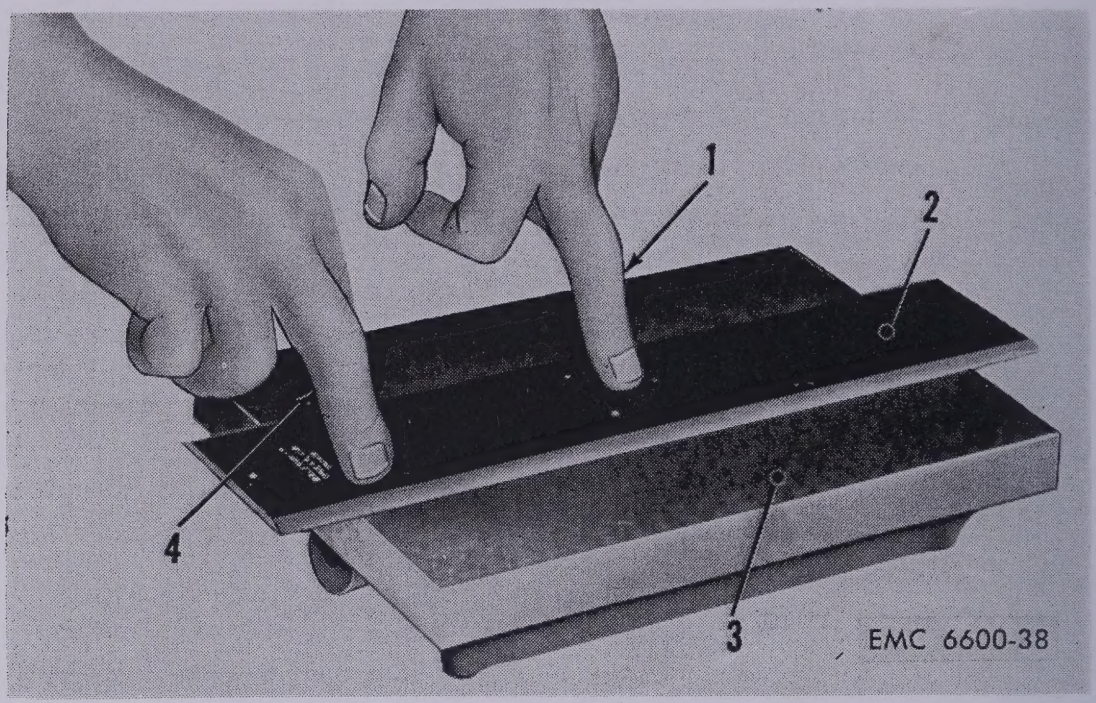
e. DD Form 6 (Report of Damaged or Improper Shipment).

Section II. DESCRIPTION AND DATA

3. Description

Alidades can be described as straightedges, with sighting and leveling devices attached. This manual covers six Keuffel and Esser alidades, Models 5093A, 5187A, P5093A, 5095A, 5189A, and

them to the proper authority. Check the base plate (1, fig. 38) by placing it on a surface plate (3) which is positioned on a firm surface. Steady the base plate (2) with the finger (1) of one hand and tap the plate with the finger (4) of the free hand. If the base plate is level, tapping the plate will produce a dull thud. If the base plate is bent, tapping will result in a metallic rapping between the base plate and the surface plate. Another way is to move the base plate around on the surface plate, exerting pressure. Turn the plate over and examine for high spots which will be shiny.



1 Steadying finger
2 Base plate
3 Surface plate
4 Tapping finger

Figure 38. Testing base plate for bends and high spots.

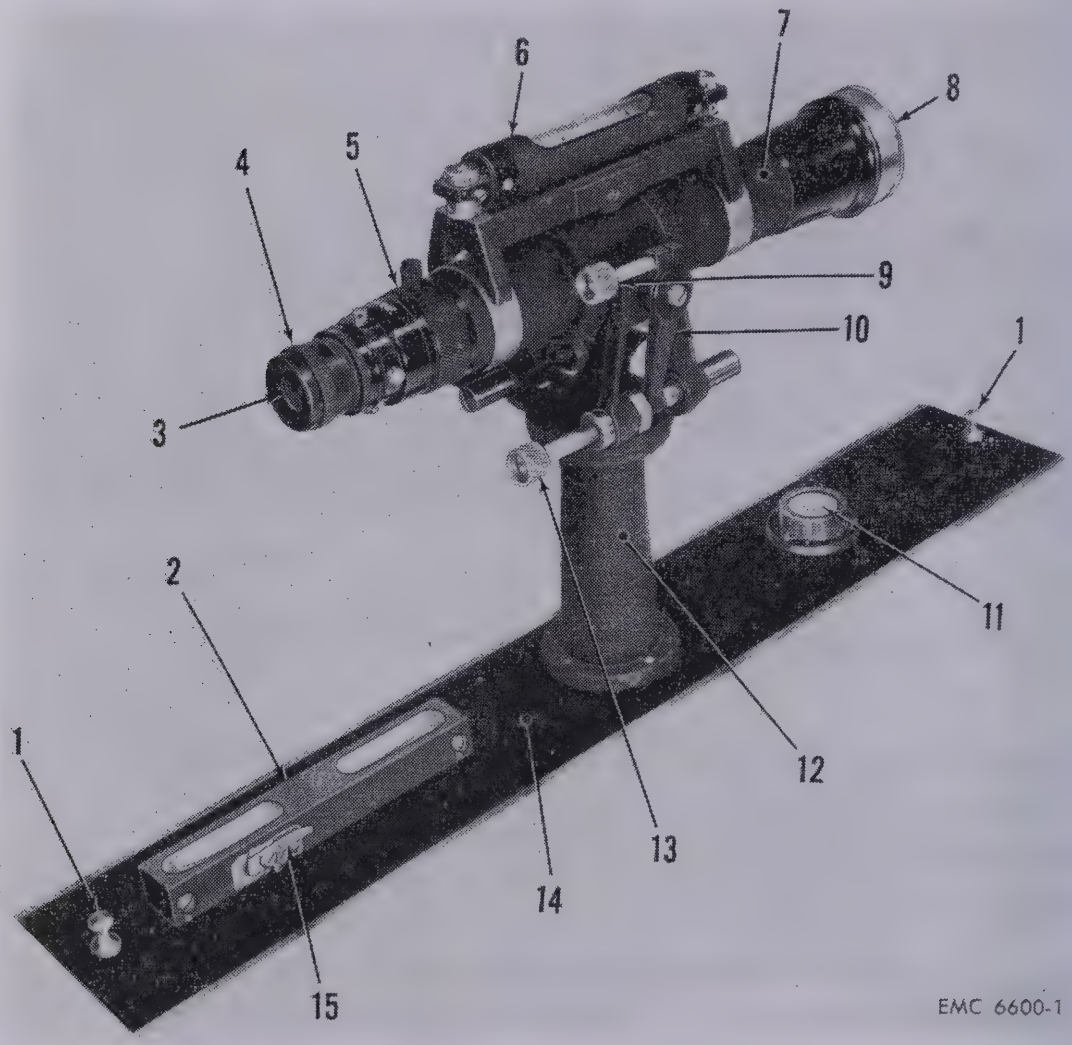
c. Repair.

(1) Minor bends in the base plate (1, fig. 39) may be straightened by placing the base plate on the edge of a flat surface (2) and pressing down on the free end with the palm of the hand. Press only a little at a time, and constantly recheck the base plate on the surface plate for level condition.

(2) If the base plate contains high spots or sharp bends, position the base plate (2, fig. 40) on two blocks of wood with the blocks on either side of the high spot or bend. Strike the base plate on the portion between the two blocks and check for level condition. Repeat the procedure as often as needed until the base plate is level.

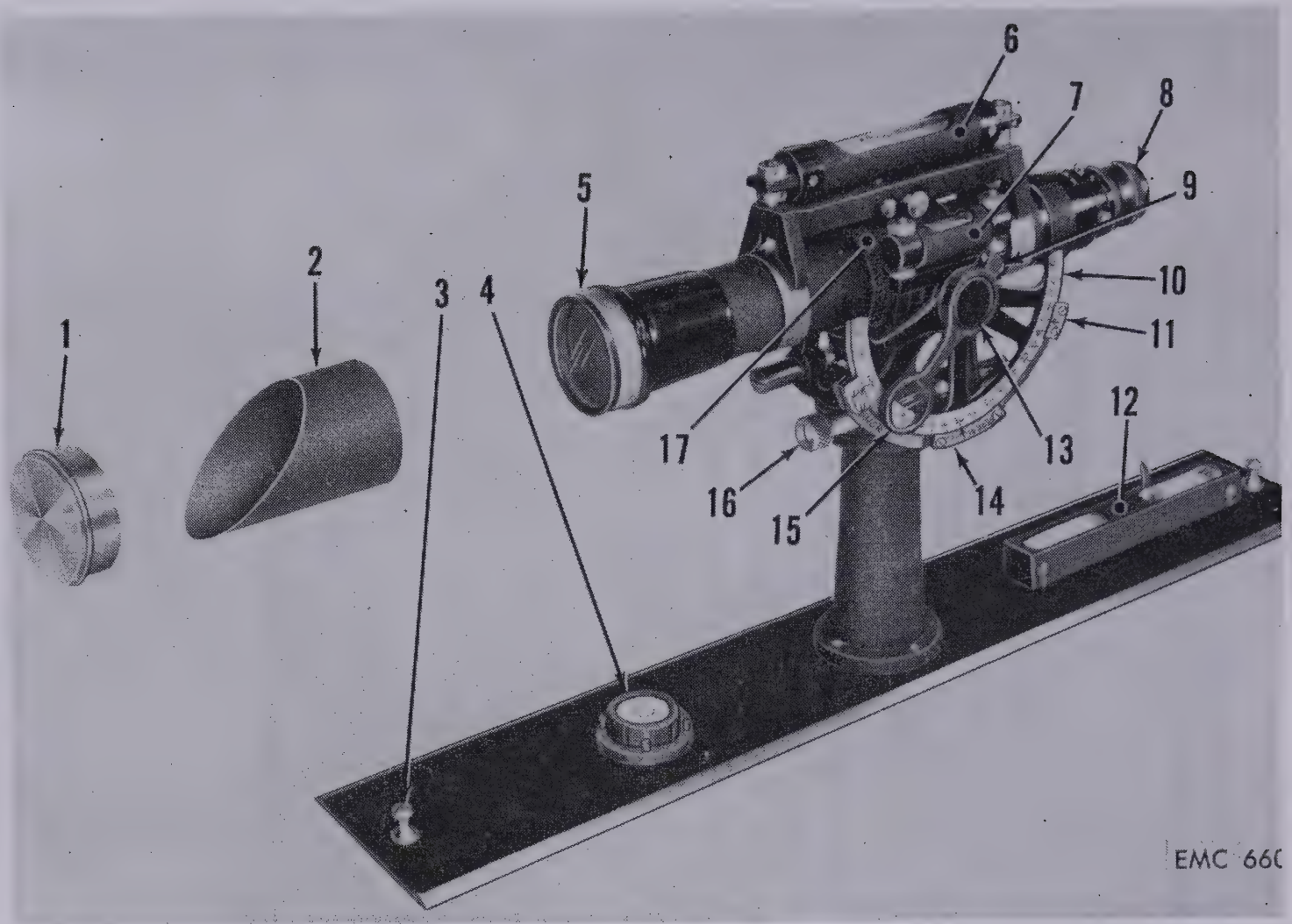
(3) Check the tangent thumbscrew for freedom of motion. If the thumbscrew binds or will not turn, replace both the tangent thumbscrew and bushing.

P5095A. All six models are of the internal focusing type, each having a sliding negative lens within the telescope to focus the image of the target. Telescopic models 5093A, 5187A, and P5093A (figs. 1, 2, and 3) have the telescope bodies (7, fig. 1) mounted on pedestals (12) which are fastened to the base plate (14). Miniature telescopic alidade models 5095A, 5189A, and P5095A (figs. 4–7), are mounted on standards (6, fig. 4) which bring the telescope body (5) close to the base plate (16, fig. 5). Striding levels (6, fig. 1) are used with both the telescopic and miniature telescopic model alidades, as are base plate levels (11), mounted on the base plate (14), and control levels (7, fig. 2), mounted on the arc assembly. A trough compass (12), or a damp-inducted compass (6, fig. 3), is used with both the



1 Base plate knob
2 Trough compass
3 Eyepiece cap
4 Eyepiece focusing ring
5 Objective focusing ring
6 Striding level
7 Telescope body
8 Objective lens assembly
9 Telescope clamp thumbscrew
10 Telescope clamp
11 Base plate level
12 Pedestal
13 Base tangent thumbscrew
14 Base plate
15 Compass lever

Figure 1. Telescopic alidade, models 5093A and 5187A, right side.



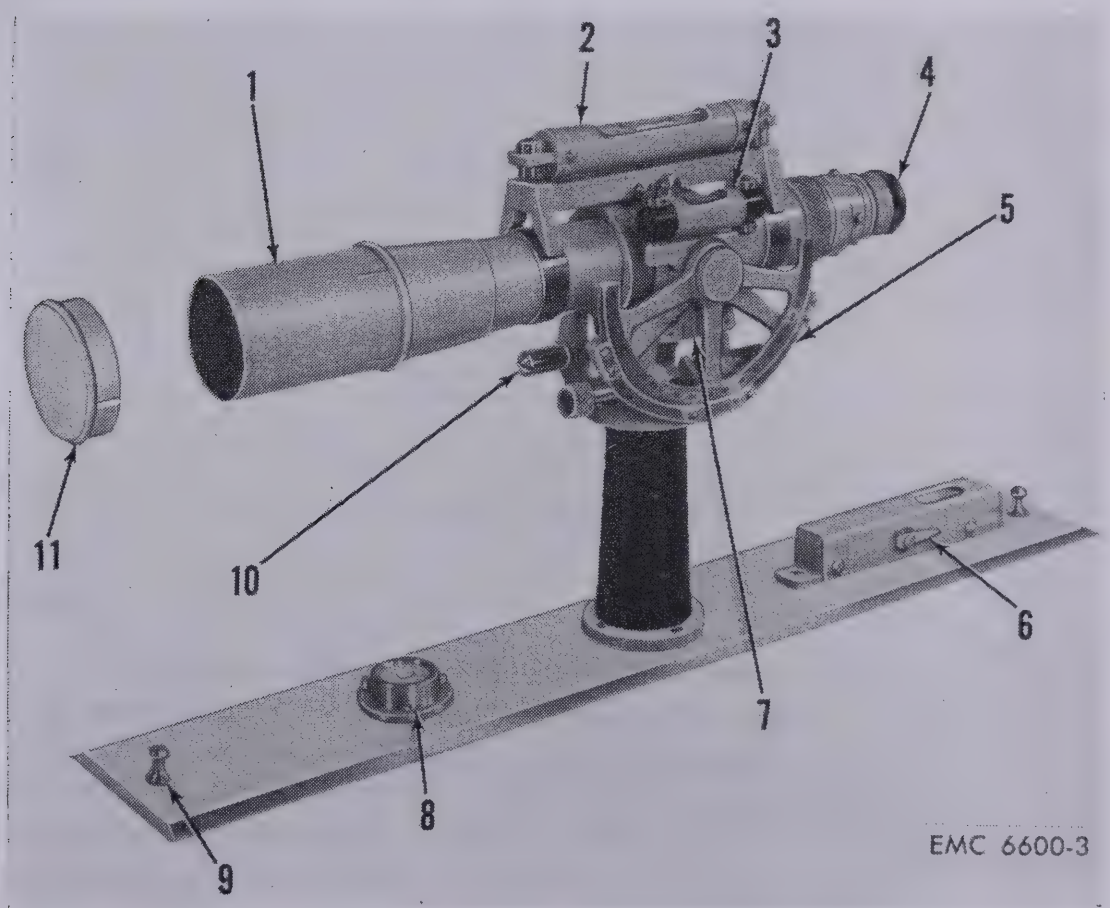
1 Dust cap
2 Sunshade
3 Base plate knob
4 Base plate level
5 Objective lens
6 Striding level vial
7 Control level
8 Eyepiece focusing ring
9 Magnifier screw
10 Vertical arc
11 Vernier arc indice
12 Trough compass
13 Telescope axle rosette
14 Vernier
15 Indice magnifier
16 Telescope tangent thumbscrew
17 Telescope lock ring

Figure 2. Telescopic alidade, models 5093A and 5187A, left side.

telescopic and miniature telescopic models, and is mounted on the base plate (14, fig. 1). The operating principles of all six model alidades are the same.

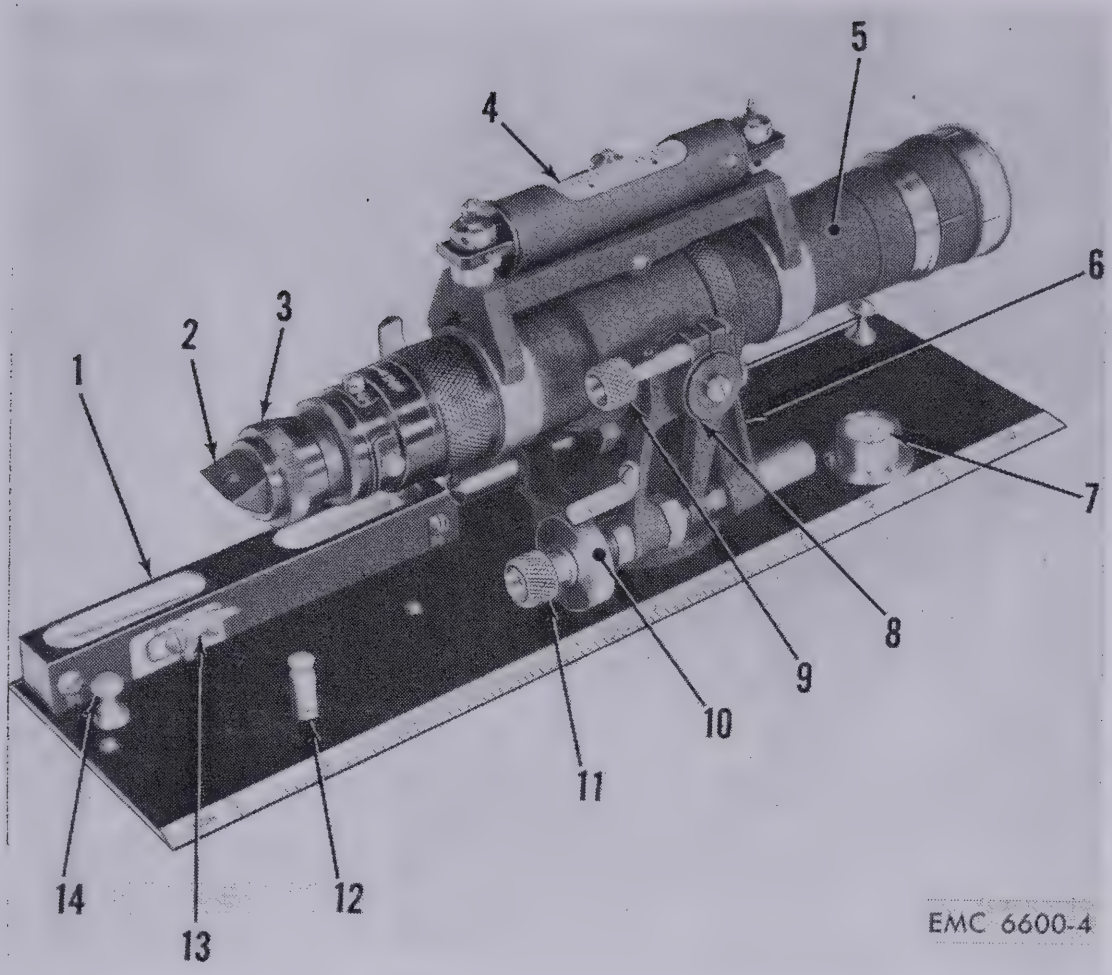
4. Identification

There are no Corps of Engineers identification plates or markings on any of the alidades or their carrying cases. Both the telescopic and miniature telescopic alidades are engraved on the base plate with the manufacturer's name (B, fig. 8), serial number, date, model number, and US. The telescopic alidade carrying case has a manufacturer's nameplate fastened to the front edge of the carrying case lid (D), and may or may not have a second manufacturer's nameplate (C) fastened to the inside of the lid of the carrying case. The miniature alidade carrying cases have a manufacturer's nameplate (A) fastened either on the inside of the carrying case lid, or on the inside of the carrying case proper.



1 Sunshade
2 Striding level
3 Control level
4 Eyepiece
5 Vernier arc
6 Damp-inducted compass
7 Bearing bracket
8 Base plate level
9 Base plate knob
10 Telescope plunger housing
11 Dust cap

Figure 3. Telescopic alidade, model P5093A, left side.

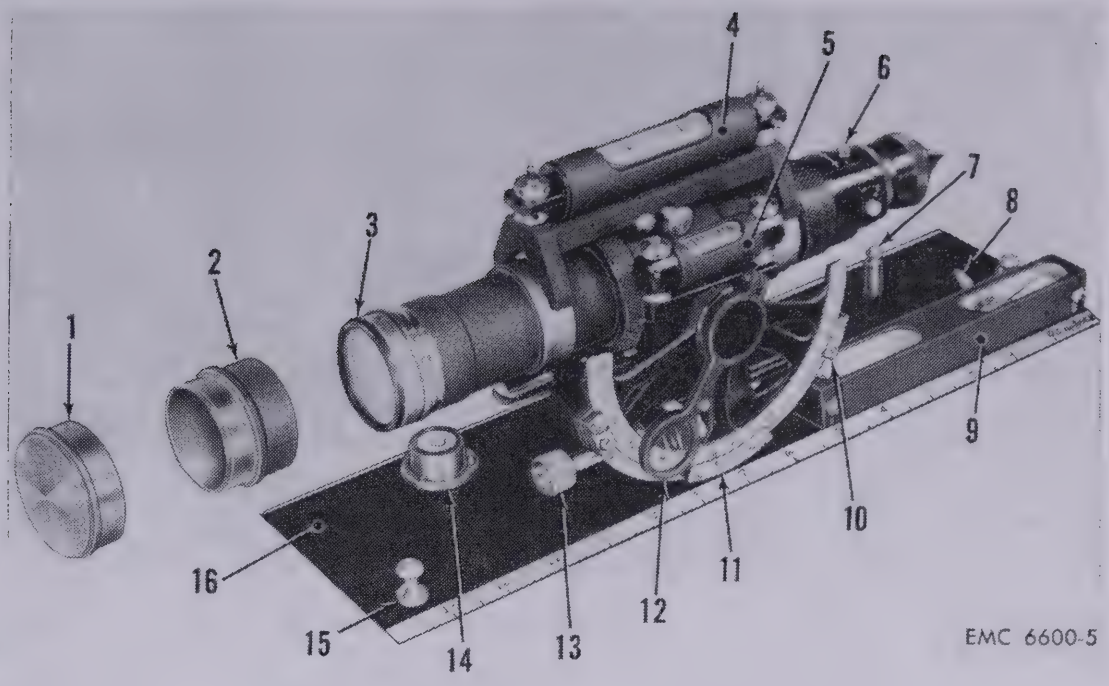


1	Trough compass	8	Telescope clamp
2	Prism assembly	9	Telescope clamp thumbscrew
3	Eyepiece focusing ring	10	Gradienter control dial
4	Striding level	11	Gradienter thumbscrew
5	Telescope body	12	Striding level stud
6	Telescope standard	13	Compass lever
7	Base plate level	14	Base plate knob

Figure 4. Miniature telescopic alidade, models 5095A and 5189A, right side.

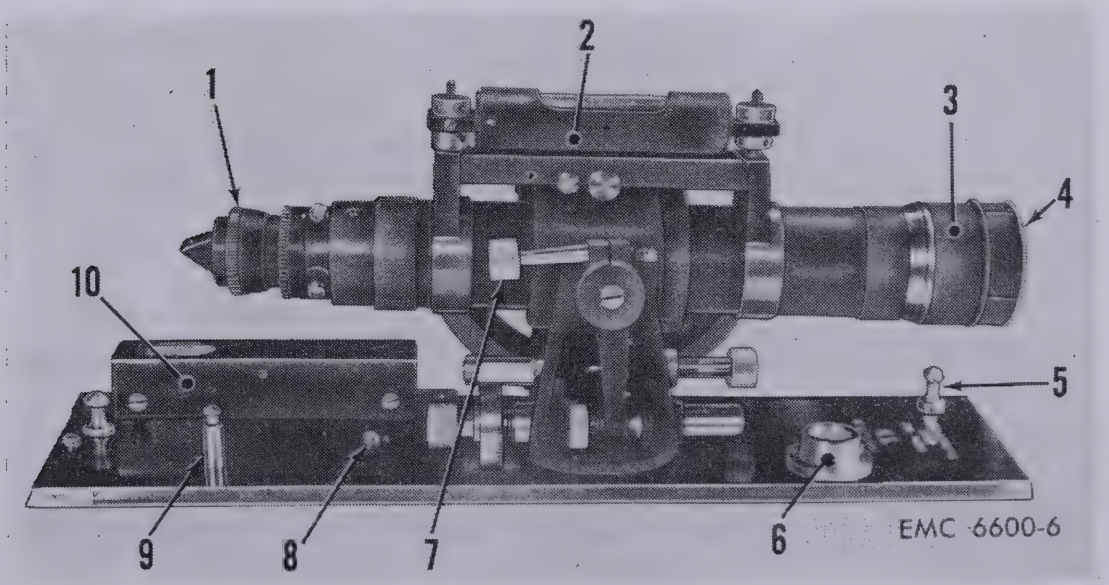
5. Differences in Models

This manual covers six different models of Keuffel and Esser alidades as indicated in paragraph 1. Differences between the six models is so great that it will be necessary to describe such differences in detail in appropriate sections and paragraphs. With the exception of minor items, such as screws, replacement items are virtually impossible to interchange between models, due to the fact that most parts are hand-fitted to the particular instrument.



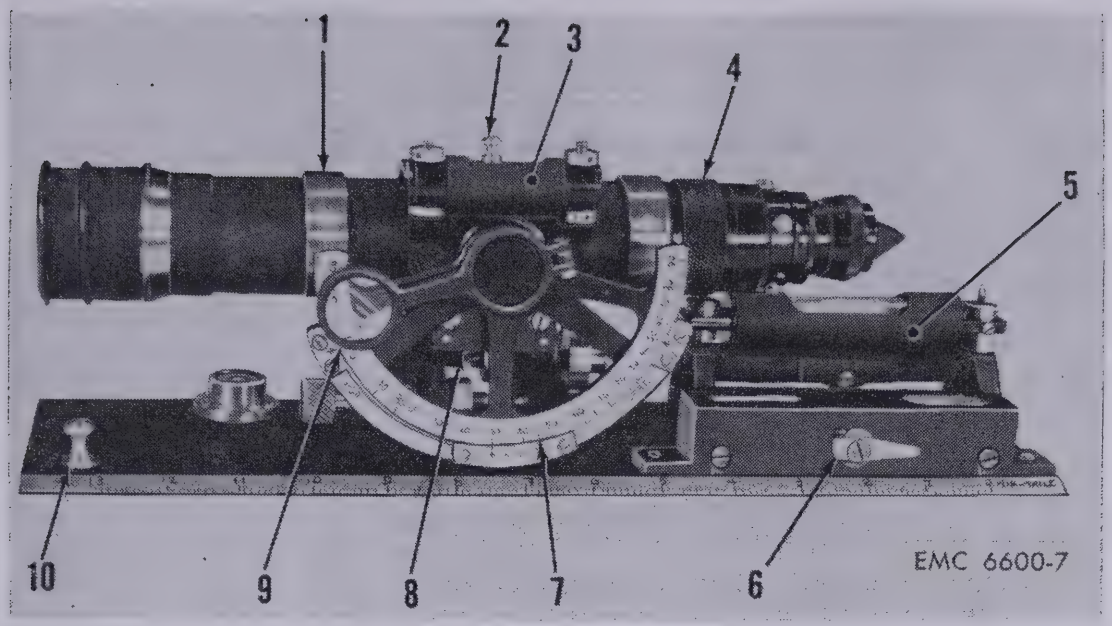
1 Dust cap
2 Sunshade
3 Objective lens
4 Striding level
5 Control level
6 Reticule adjusting screws
7 Striding level stud
8 Compass lever
9 Trough compass
10 Vertical arc
11 Telescope vernier
12 Indice magnifier
13 Telescope tangent thumbscrew
14 Base plate level
15 Base plate knob
16 Base plate

Figure 5. Miniature telescopic alidade, models 5095A and 5189A, left side.



1 Prism assembly
2 Striding level
3 Sunshade
4 Dust cap
5 Base plate knob
6 Base plate level
7 Telescope clamp thumbscrew
8 Striding level stop screw
9 Striding level mounting stud
10 Damp-inducted compass

Figure 6. Miniature telescopic alidade, model P5095A, right side.

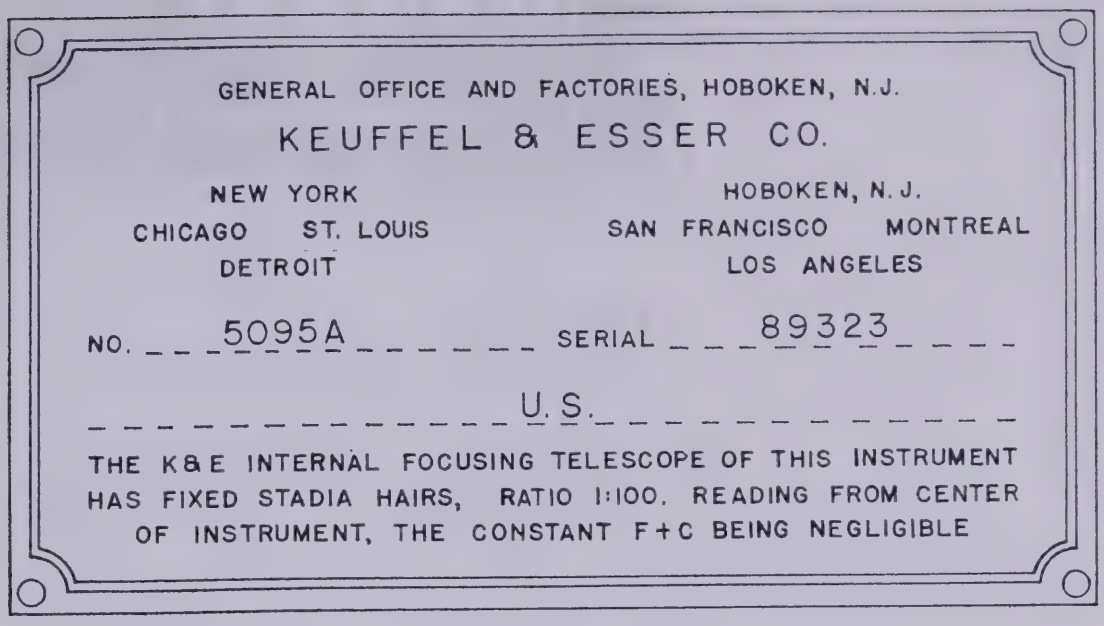


1	Striding level bearing	6	Damp-inducted compass
2	Striding level stud	7	Vernier arc
3	Control level	8	Bearing bracket
4	Telescope slide focusing ring	9	Indice magnifier
5	Striding level	10	Base plate knob

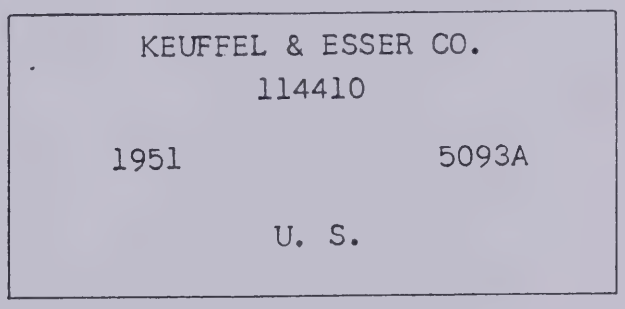
Figure 7. Miniature telescopic alidade, model P5095A, left side.

6. Tabulated Data

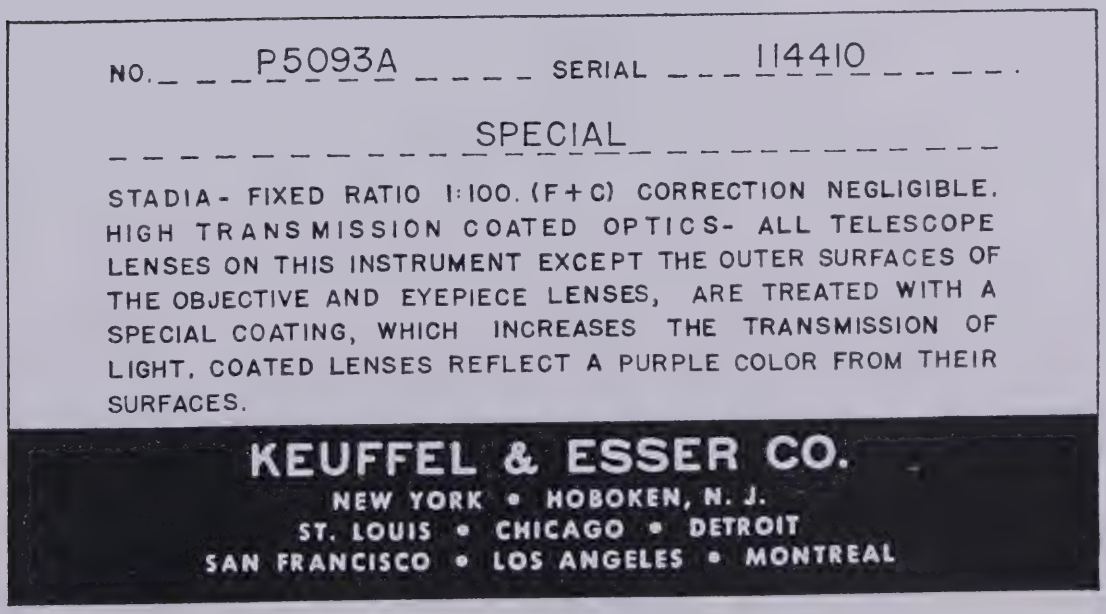
Model	5093A	P5093A	5187A	5095A	P5095A	5189A
Telescope:						
Focusing:						
Internal	X	X	X	X	X	X
External						
Image inverted	X	X	X	X	X	X
Length	10⅜ in.	10⅜ in.	10⅜ in.	9½ in.	9½ in.	9½ in.
Aperture	1.36 in.	1.36 in.	1.36 in.	1.14 in.	1.14 in.	1.14 in.
Focal length	10 in.	10 in.	10 in.	8⅜ in.	8⅜ in.	8⅜ in.
Minimum focus.	10 ft	10 ft	10 ft	10 ft	10 ft	10 ft
Magnification	16X (power)	16X	16X	14X	14X	14X
Striding level:						
Vial length	3 in.	3 in.	3 in.	2¼ in.	2¼ in.	2¼ in.
Sensitivity	45 sec. per 2-mm	45 sec. per 2-mm	45 sec. per 2-mm	45 sec. per 2-mm	45 sec. per 2-mm	45 sec. per 2-mm
Vernier control level:						
Vial length	1.3 in.	1.3 in.	1.3 in.	1.3 in.	1.3 in.	1.3 in.
Sensitivity	60 sec. per 2-mm	60 sec. per 2-mm	60 sec. per 2-mm	60 sec. per 2-mm	60 sec. per 2-mm	60 sec. per 2-mm



A



B



C

EMC 6600-8 '1

Figure 8. Manufacturer's identification plates and markings.

D

EMC 6600-8/2

Figure 8—Continued.

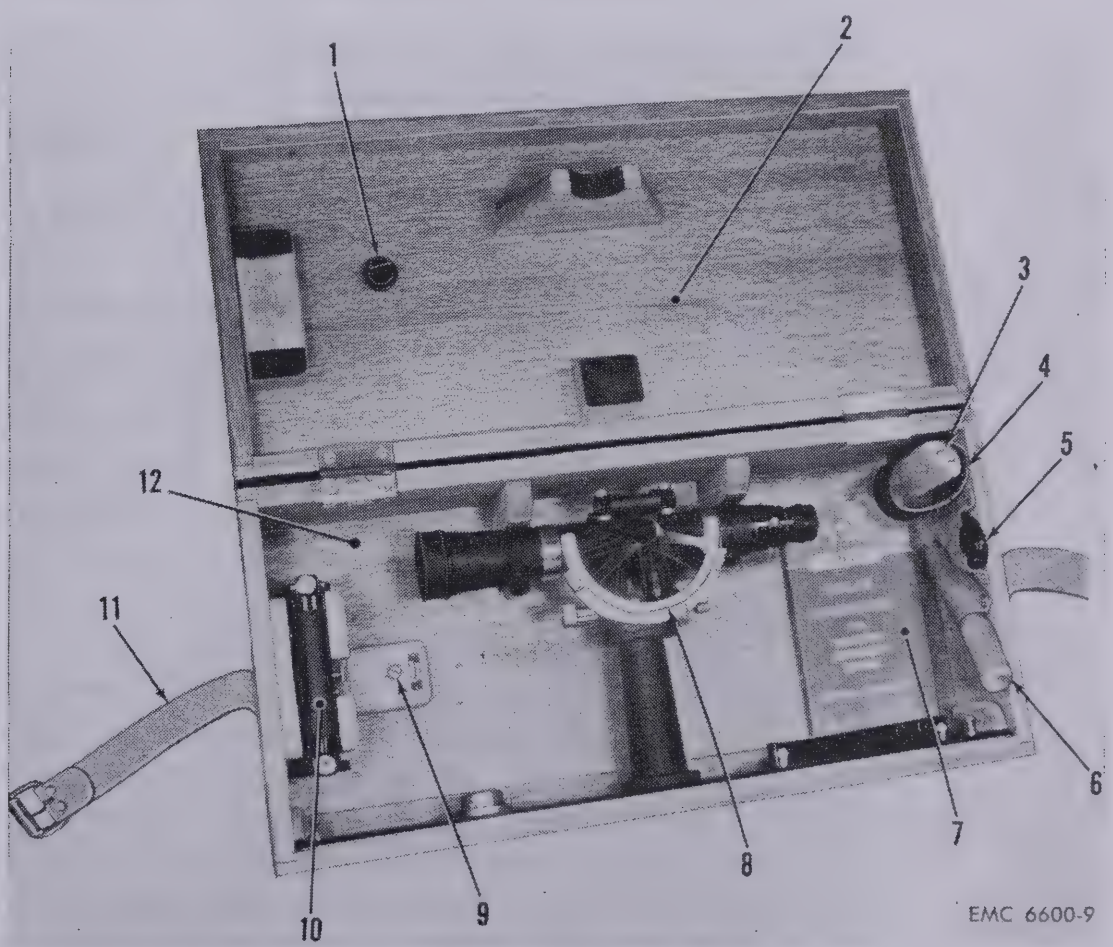
Model	5093A	P5093A	5187A	5095A	P5095A	5189A
Cicular level:						
Diameter	¾ in.	¾ in.	¾ in.	$\frac{9}{16}$ in.	$\frac{9}{16}$ in.	$\frac{9}{16}$ in.
Vertical-arc:						
Graduation	30 min	30 min	30 min	30 min	30 min	30 min
Angle of elevation.	25 deg	25 deg	25 deg	25 deg	25 deg	25 deg
Angle of depression.	20 deg	20 deg	20 deg	20 deg	20 deg	20 deg
Straightedge:						
Length	18 in.	18 in.	18 in.	11½ in.	11½ in.	11½ in.
Width	3 in.	3 in.	3 in.	2¼ in.	2¼ in.	2¼ in.
Instrument:						
Height	7¼ in.	7¼ in.	7¼ in.	2½ in.	2½ in.	2½ in.
Weight	7 lb	7 lb	7 lb	5 lb	5 lb	5 lb
Weight, w/ carrying case.	14¼ lb	14¼ lb	14¼ lb	7¾ lb	7¾ lb	7¾ lb

CHAPTER 2
OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

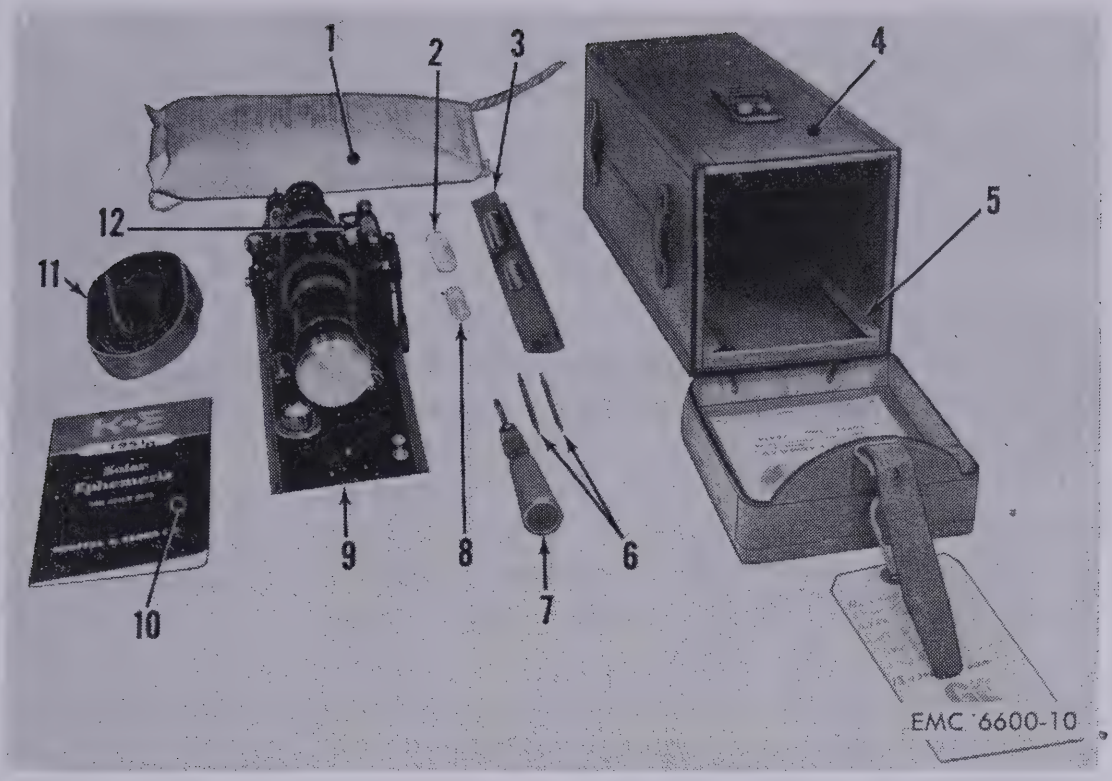
7. General

Alidades are packed the same for both domestic and oversea shipment. Telescopic alidades are packed in a wooden carrying case (fig. 9). Miniature telescopic alidades are packed in a leather carrying case (fig. 10). The carrying case is inclosed in a sealed cardboard carton, which, in turn, is packed in a wooden shipping box.



1 Prism
2 Carrying case lid
3 Adjusting pins
4 Sunshade
5 Magnifying glass
6 Screwdriver
7 Manufacturer's manual
8 Telescopic alidade
9 Level vial holder
10 Striding level
11 Carrying case sling
12 Carrying case body

Figure 9. Carrying case, telescopic alidade.



1	Desiccant	7	Screwdriver
2	Striding level vial	8	Control level vial
3	Vial holder	9	Miniature telescopic alidade
4	Carrying case	10	Manufacturer's manual
5	Alidade mounting bracket	11	Carrying case sling
6	Adjusting pins	12	Compass

Figure 10. Carrying case, miniature telescopic alidade.

a. Unloading. Unloading alidades, even when the instruments may be shipped in multiple containers, does not present any particular problems as to weight-to-volume ratio. The packing cases are and should be stenciled FRAGILE, and they must be handled carefully to prevent injury to the instrument. Check the condition of the packing case. If the packing case shows evidence of damage incurred during shipment, the damage should be a matter of record, photographically, if possible.

b. Uncrating.

(1) Remove the screws, holding the lid of the shipping box, and remove the lid. Remove enough of the shredded paper enclosing the cardboard container so the container can be lifted from the wooden shipping box.

(2) Open the top of the cardboard container. Remove any cardboard shims that may have been inserted in the cardboard container to keep the carrying case from moving. Lift out the sealed envelope containing the carrying case and instrument.

(3) Open the sealed waterproof envelope and remove the shock-absorbing material, and large desiccant bags, (1, fig. 10).

If present, remove small desiccant bags from the carrying case (12, fig. 9) and (4, fig. 10).

Note. When cutting the sealed, waterproof envelope with a sharp instrument, be careful not to cut or damage the carrying strap and carrying case.

8. New Instruments

a. Unpacking. Take care when unpacking a new instrument not to subject it to heavy blows or jars. Unstrap the carrying case and open the lid. Remove as much of the packing from the carrying case as possible, as well as any small bags of desiccant which may be present. Alidade carrying cases are especially designed to hold the instrument and its accessories in a secure manner. Be sure to notice the exact position of the alidade in the case before removing it. It must be put back into the case in exactly the same position or it will not fit.

b. Removing the Alidade From the Carrying Case.

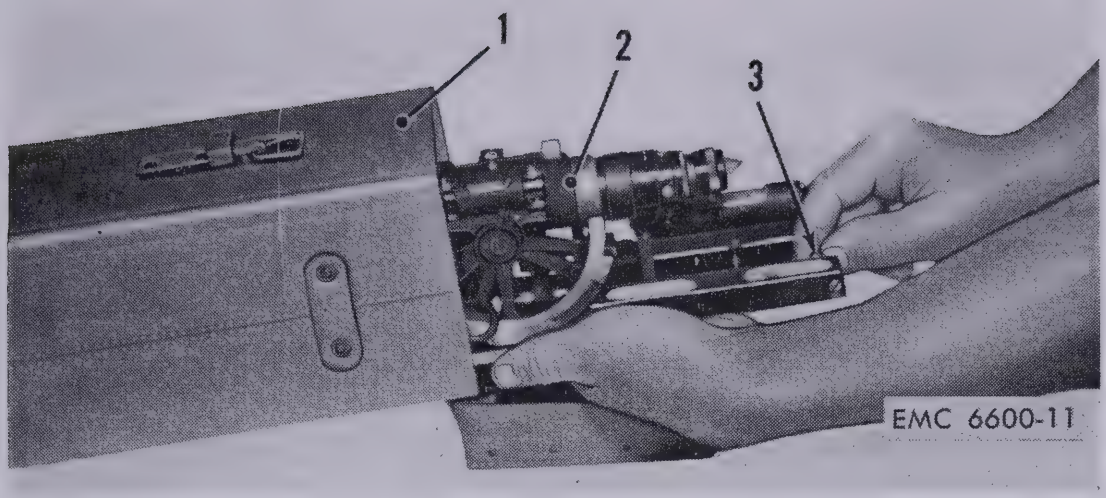
(1) When removing the telescopic alidade (fig. 9) from its case, raise the lid and remove the packing and bags of desiccant (1, fig. 10) from around the instrument. Grasp the alidade by the pedestal (12, fig. 1) and lift it from its cradle in the case. Set the instrument on a firm level surface. Remove the waterproof paper wrapping from the instrument. Remove the lens tissue from the eyepiece (3), trough compass (2), control level (7, fig. 2), and base plate level (4). Remove lens tissue from the striding level (10, fig. 9), prism (1), compass (2, fig. 1), and vial holder (9, fig. 9) in the carrying case (12).

(2) When removing the miniature telescopic alidade (2, fig. 11) from its carrying case (1), unstrap and raise the end lid. Lay the carrying case on a firm, flat surface with the lid open. Remove as much of the packing material and desiccant as possible. Grasp the base plate knob (3, fig. 11) with the thumb and fingers and withdraw the alidade (2) from the carrying case (1), sliding the base plate (16, fig. 5) over and on the palm of the other hand. When lifting the miniature telescopic alidade, slide the thumb between the arc (3, fig. 12) and the telescope (1) and grasp the standard on the other side of the telscope axle (2) with the fingers.

Note. Never lift the telescopic or miniature telescopic alidades by the telescope. Always lift the telescopic alidade by the pedestal, and the miniature telescopic alidade as shown in figure 12.

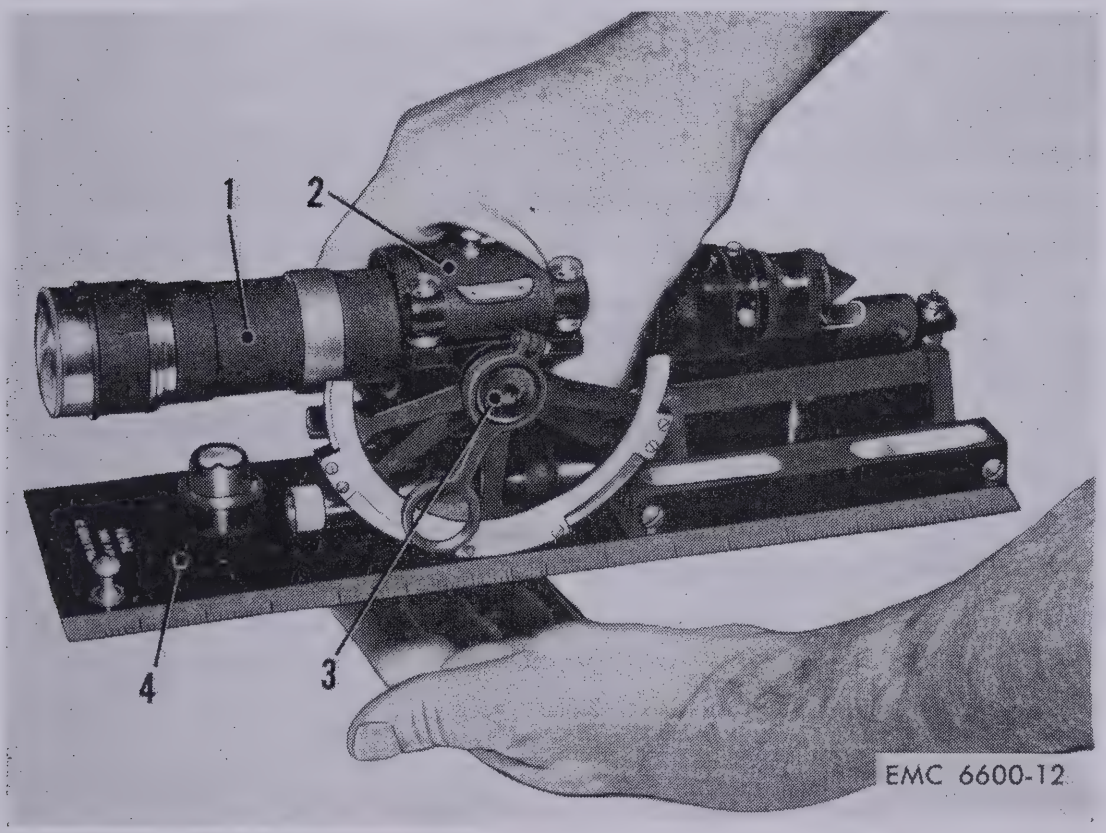
c. Inspection.

(1) Inspect the inside of the carrying case for signs of wear which may have been caused by the bumping or rubbing of



1 Carrying case
2 Alidade
3 Base plate knob

Figure 11. Removing miniature telescopic alidade from carrying case.



1 Telescope
2 Telescope axle
3 Arc assembly
4 Base plate

Figure 12. Proper way to lift miniature telescopic alidade.

the alidade during shipping and handling. Check the alidade parts corresponding to the location of the marks in the carrying case for wear or damage.

(2) Operate all clamps and tangent screws to insure the alidade is in good operating condition.

(3) Examine the instrument carefully, looking for bent or broken parts, chipped or broken lenses, missing screws, and other deficiencies.

(4) Run the objective focusing ring (5, fig. 1) through its full travel and check for any binding or friction. Run the eyepiece focusing ring (4) through its full travel and check for any binding or friction. Repair, or report any malfunction to the proper authority.

(5) Look into the objective end of the telescope body (7, fig. 1) and check the lens (5, fig. 2) for traceries of fungus. Check the double lens assemblies for traceries of fungus, and the reticule assembly for good condition, by looking through the eyepiece with the telescope directed against a plain, light background. Replace a broken or damaged reticule (pars. 59–62), but do not attempt to repair broken lenses covered with fungus. Lens repair is a fifth echelon repair responsibility and defective or broken lenses should be referred to them.

(6) Check the trough compass (12, fig. 2) for proper operation. Inspect the level vial (6 and 7) and base plate level (4) for damage and improper operation. Replace broken or defective trough compass (par. 48), and reset and replace any broken or defective level vials (par. 43).

(7) Determine the cause of any binding or sticking in any of the movements, and clean, lubricate, and repair, or refer the condition to the proper authority.

(8) Check the base plate (14, fig. 1) for bends and breaks. If bent, remove the trough compass (par. 48), and base plate vial (par. 48), and straighten, or report the condition to the proper authority.

(9) Check the telescope body (7) for damage and defective operation. Report defective telescope to the proper authority.

d. Service.

(1) Wipe all surfaces with a soft, dry cloth to remove any dirt and excess oil.

(2) Clean lens surfaces with lens tissue or soft, clean camel's hair brush. Do not rub or scrub: dust is composed of minute particles which sometimes are very abrasive, and will scratch glass surfaces.

Note. Never use cloth, or materials other than lens tissue or camel's hair brush when cleaning lenses of any surveying instrument.

9. Used Instruments

a. Unpacking. Follow the general procedures in paragraphs 7 and 8.

b. Inspection. Perform the inspection procedures as prescribed in paragraph 8*c*.

c. Service.

(1) Perform the services as prescribed in paragraph 8*d*.

(2) If the alidade received has been stored under adverse conditions, it should be cleaned and lubricated as described in paragraph 30.

Section II. OPERATING CONTROLS

10. General

This section describes, locates, and states the purpose of the controls on the alidade.

11. Focusing Controls

a. Eyepiece Focusing Control. The focus of the eyepiece is controlled by a knurled focusing ring, located on the eyepiece assembly (3, fig. 4).

b. Objective Focusing Control. The image of the objective (target) is focused on the crosshairs of the reticule, by turning the objective focusing ring (5, fig. 1).

12. Leveling Controls

a. Control Level. The control level (7, fig. 2 and 5, fig. 5), located on top of the vertical arc assembly, consists of a level vial, the reading of which enables the instrumentman to level the plane table when the verticle arc (10, fig. 2) is set to read 30°.

b. Striding Level. The striding level (6, fig. 1 and 4, fig. 5) is an attachment set astride the telescope and locked to the striding level mounting stud (2, fig. 7) when in use, and is carried on the striding level stud (9, fig. 6) on the straightedge blade of the miniature telescopic alidade when not in use. It is carried in the carrying case of the telescopic alidade when not in use. The striding level is used to check the horizontal line of sight reading when the control level bubble is centered in the vial.

c. Base Plate Level. The base plate level (11, fig. 1 and 7, fig. 4), mounted on the base plate (14, fig. 1), is used for approximating the level of the plane table.

13. Sighting Controls

a. Clamp Screw. The clamp screw (9, fig. 1), located near the telescope axle, is used to clamp and hold the motion of the telescope in the vertical plane.

b. Tangent Screw. The tangent screw (16, fig. 2), located just forward of the vertical arc assembly, is used to control the elevating or depressing of the telescope, within small limits, for the purpose of bringing the reticule intersection onto the target accurately.

c. Compass Lever. The compass lever (15, fig. 1), located on the side of the trough compass (2) housing, locks the compass needle when the compass is not in use, and releases the needle when the compass and alidate are being used.

Section III. OPERATION UNDER USUAL CONDITIONS

14. General

The procedures and techniques involved in conducting military surveys are beyond the scope of this manual, and are fully described in TM 5–232, TM 5–233, and TM 5–234. This manual is limited to—

a. Describing the alidades and their major assemblies.

b. Relating these assemblies to other components of the instruments.

c. Giving information on the mechanical operation of the alidades only so far as this information is necessary to a discussion of the organizational maintenance of the instruments, and the field replacement and repair of their parts.

d. Describing adjustments necessary to eliminate malfunctions of components of the alidades. The scope of this manual does not permit a discussion of the operation of the alidades, as opposed to mechanical adjustments, nor a discussion of the adjustments applied to the readings obtained from observations and sightings made through the instrument.

15. Setting Up

The alidade is used on a plane table, which is set up at each station according to the procedures given in TM 5–232. The plane table is leveled by adjusting the legs of the tripod, using the bubble of the base plate level (11, fig. 1) on the base plate (14) as a guide. Final leveling adjustments on the plane table are made with the Johnson head of the plane table tripod, using the bubble on the control level (7, fig. 2) on the vertical arc as a check.

16. Handling the Instrument

a. General. Telescopic alidades (fig. 1) should always be handled, when out of their carrying cases, by grasping the pedestal. Miniature

alidades should be lifted as shown in figure 12. Both types of alidades are moved around on the plane table by means of the base plate knobs (9, fig. 3) at each end of the base plate (16, fig. 5).

b. Removing the Alidade From Its Carrying Case. Follow the procedures given in paragraph 8*b*.

c. Replacing the Alidade in Its Carrying Case.

(1) Tighten all tangent thumbscrews (13) and clamp screws (9, fig. 1), then back off the tangent screw a small fraction of a turn to hold, yet not to bind. This is to allow a shock-absorbing motion, but not a damaging play, in the moving parts.

(2) Set the instrument back in the carrying case (par. 8*a* and *b*) in the same position in which it was packed so that it will slip snugly and easily into the carrying case. Set the striding level (4, fig. 4) securely on the level stud (12) on the base plate of the miniature telescopic model alidade. Place the striding level (10, fig. 9) in its mounting in the carrying case (12) on the telescopic model alidade.

d. Protecting the Alidade When Not in Service. Select a storage place where the alidade will be protected against jars, vibration, and moisture. Never leave the alidade in a vehicle, or other exposed place, overnight.

17. Care of the Alidade During Operations

a. Moving to Location. Always carry the alidade in its carrying case between the storage place and the starting point of the survey. The instrument must always be stowed in its case as described in paragraph 16, and the carrying case properly closed and fastened. Handle the carrying case carefully to avoid sudden jolts, continued vibration, or other shocks and motions which might damage the delicate parts or throw them out of adjustment. Do not drop the case into a vehicle or on the ground. If, by accident, the case is dropped, the alidade should not be used until it has been thoroughly checked for damage, and readjusted if necessary.

b. Moving from One Point to Another. When moving from one setup to another, always transport the alidade in its carrying case, even in clear areas. Protect the alidade against blows and scratches.

c. Cardinal Rules.

(1) Never leave the alidade unattended when it is out of its carrying case.

(2) Never set up the plane table without finding good footing for the tripod, and spreading the legs wide to insure stability. Make sure the wingnuts are tight.

Section IV. ADJUSTMENTS

18. General

There are two types of adjustments for all telescopic surveying instruments: instrument, and operational adjustments.

19. Instrument Adjustments

Instrument adjustments bring the alidade into proper operating condition with respect to the interrelationship of its parts. Instrument adjustments are normally made in the shop, or at the home location, before the alidade is taken into the field. Conditions which can be corrected by instrument adjustments are—

a. Crosshairs Not Centered. Proper collimation of the crosshairs will make the line of sight through the intersection of the crosshairs coincide with the axis of the line of sight (TM 5–232).

b. Crosshairs Not Plumb. Proper adjustment of the reticule will make the vertical crosshair perpendicular to the horizontal axis of the telescope, unless the standard and pedestal assembly is canted. If so, the pedestal will require shimming (TM 5–232).

c. Stadia Arc Not Reading True. Proper adjustment of the stadia arc will make it read the true factors for horizontal corrections (TM 5–232).

d. Control Level Out Of Adjustment. When the control level bubble is centered, the vertical arc should read 30°. To adjust see TM 5–232.

e. Base Plate Level Out Of Adjustment. If the base plate level is out of adjustment, refer to TM 5–232.

20. Operational Adjustments

Operational adjustments bring the alidade into proper relationship with the terrain being surveyed, and are required at each instance of changing the setup during actual surveying operations. Operational adjustments correct the focus of the images in the telescope; assure a level setup of the alidade and plane table; and enable the instrumentman to point the instrument accurately. Operational adjustments are—

a. Adjusting Focus. Correct focusing of the objective image on the reticule crosshairs determines the accuracy of all readings, and should be done before taking any readings.

(1) Sight through the telescope and rotate the knurled eyepiece focusing ring (4, fig. 1) until the crosshairs appear sharp and black. Move the eyepiece focusing ring, even though the crosshairs appear sharp and black at first glance.

Move the ring clockwise until the crosshairs become fuzzy, then move the ring back counterclockwise until the image appears sharp and black, and then begins to appear fuzzy again. Turn the ring clockwise slowly until the crosshairs are sharpest and blackest.

Note. Keep both eyes open while sighting through the telescope.

(2) Sight on a clearly defined, well lighted target about 100 yards away and focus the objective lens by turning the objective focusing ring (5, fig. 1).

(3) Slowly rotate the objective focusing ring to right and left to get the best image of the target, and move the eye slightly from one side to the other and back again. When there is no apparent movement of the target toward or away from the crosshairs, parallax has been removed and the objective lens is correctly focused.

(4) The telescope will then be in focus for the individual who adjusted it. The image may have to be sharpened by refocusing, which will also make the crosshairs more distinct.

(5) The instrument will not have to be focused again for that setup until the eye becomes tired, or if another observer uses the instrument, at which time the above procedures should be repeated.

(6) The instrument eyepiece should always be focused at the beginning of a day's work, or when it appears to be out of focus, due to movement of the alidade or its controls.

b. Leveling the Instrument. The plane table tripod is set up approximately level and the plane table is made level by adjusting the Johnson head on the tripod, and using the base plate level (11, fig. 1) as a guide. Detailed instructions for leveling the instrument are given in TM 5–232.

c. Pointing the Line of Sight. The line of sight is pointed at each target by observation, moving the alidade on the plane table by means of the base plate knobs (1, fig. 1). The line of sight is elevated or depressed to bring the reticule intersection onto the target as follows:

(1) Loosen the clamp screw (9) by turning the clamp screw knob.

(2) Elevate or depress the telescope sufficiently to bring the target approximately to the center of the reticule.

(3) Tighten the clamp screw.

(4) Adjust the pointing by turning the tangent-screw knob to the right or left until the target is exactly centered in the crosshairs intersection. When using the tangent screw, it is better to make the final adjustment by turning the knob

in a clockwise direction. This tightens the right hand threads of the screw so that the tangent screw is pushing against the opposing spring, thus eliminating any possible error, due to a lagging spring.

Section V. OPERATION UNDER UNUSUAL CONDITIONS

21. General

Ideal conditions for conducting a survey are firm, level, terrain with no undergrowth or objects to hinder vision; atmosphere of average temperature, clear, and chemically free; relatively low humidity and no wind current. However, most surveying must be done when conditions are not ideal, and some or all of the items in *a* and *b* below are present. Such conditions necessitate the taking of shorter sights; greater diligence must be used in making readings, and more care be given the alidade, as detailed in paragraphs 22 through 26 to prevent discrepancies in results.

a. Terrain Conditions.

(1) Spongy or unstable ground surfaces.
(2) Rough or steep terrain.
(3) Dense undergrowth and foliage.

b. Atmospheric Conditions.

(1) High humidity (formation of fungus in telescope).
(2) High temperatures and heat waves which cause incorrect readings.
(3) Wind currents.
(4) Very low temperatures, which cause contraction of metal parts and fogging of telescope lenses.
(5) Sandy—abrasive action on lenses, bearing surfaces, and moving parts.
(6) Salty—corrosion of instrument.
(7) Direct sunlight, causing uneven expansion of alidade.

22. Operation in Extreme Cold

With proper precautions and servicing, the alidade can be used in extreme cold. Its use is only limited by the endurance of the personnel, and light conditions affecting visibility. When working in extreme cold, the alidade should be kept out-of-doors, or in unheated buildings, for short periods of nonuse. Extreme changes in temperature will induce internal stresses affecting accuracy, and telescope lenses may become fogged internally. For detailed information on cold-weather surveys, see TM 5–233.

23. Operation in High Humidity

In very humid climates a slight lowering of the air temperature

will cause condensation of moisture and fogging of lenses. The best protection against fogging of lenses is to keep the alidade warmer than the surrounding air. If fogging is on the inside lens surfaces, open the telescope tube by removing the eyepiece. Cover the open end of the tube with a cloth to prevent infiltration of dust, and allow the air to circulate freely within the telescope tube. Moisture between the elements of a lens assembly can usually be removed by taking the alidade into a warm, dry, place. Do not attempt to take the objective lens apart.

24. Operation in Extreme Heat

Extreme heat alone will not affect the alidade to any marked degree. A combination of extreme heat and high humidity may induce the growth of fungus in the inside of the telescope tube. Fungus will also etch telescope lenses and render them unserviceable. Mildew and fungus can be controlled by the proper use of desiccants, dry closets, and dry heat. The place where the alidade is stored should be dry. If it is cool in the storage place, the alidade should be brought out of storage some time before use to allow the fogging, due to condensation, to dissipate.

25. Operation Under Sandy or Dusty Conditions

Special care must be taken of instruments used in areas where dust occurs. Dust, which gathers on the exposed parts, will sift into the inner parts of the alidade, and resulting abrasive action can affect the accuracy of the instrument and result in its becoming inoperable. Wipe the instrument frequently, at least once a day, being careful not to scratch lens surfaces. When it is necessary to open the telescope tube to overcome fogging, and dust is prevalent, take care to prevent dust from entering the telescope body.

26. Operation Under Salt Air Conditions

Salt-laden air is highly corrosive to many metals, and particularly brass, from which many of the alidade parts are made. Salt, combined with brass, produces a green rust (verdigris), which must be guarded against, and removed as soon as it is noticeable. Wipe the outside surfaces clean at the end of each day's work, using a cloth that has been moistened with a few drops of watch oil. In the event the alidade is exposed to direct spray from salt water, it should be washed sparingly with fresh water as soon as possible, dried thoroughly, and lightly rubbed with an oil-moistened cloth. The alidade should be returned to an instrument repair shop for disassembly, cleaning, and lubrication as soon as convenient. The cleaning and lubrication interval should be shortened considerably for instruments subjected to salt air exposure.

CHAPTER 3
ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. ORGANIZATIONAL TOOLS AND EQUIPMENT

27. General

The tools and equipment listed in this section are those that are required to perform organizational maintenance on telescopic and miniature telescopic alidades. Standard mechanic's handtools and special surveying instrument toolkits are not enumerated in this section.

28. Tools and Publications Set

There is no tool and publication set available for the alidades covered herein.

29. Special Organizational Maintenance Tools and Equipment

Tools and equipment in table I are for the use of organizational personnel performing maintenance and minor repairs on alidades. The tools listed in table I are not available for issue, but must be fabricated by qualified organizational personnel.

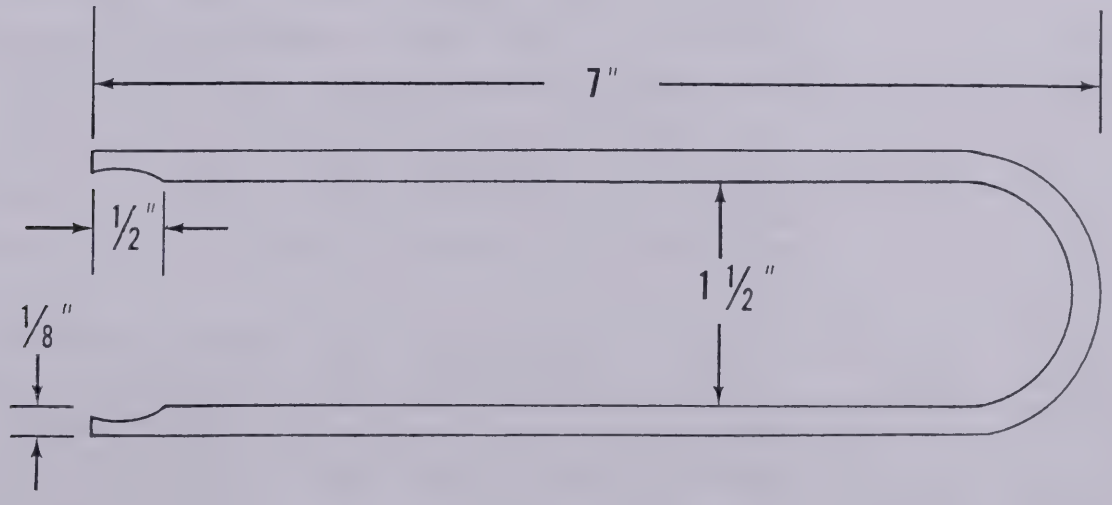


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Figure 13. Tube end remover.

Table I. Specially Designed Tools and Equipment

Item	References		Use
	Fig.	Par.	
Tube end remover	13	46*b*(5)	To remove tube ends when disassembling level vial assemblies.
Plaster remover	14	42*a*(7)	To loosen and remove plaster-of-paris holding level vials in level vial tubes.

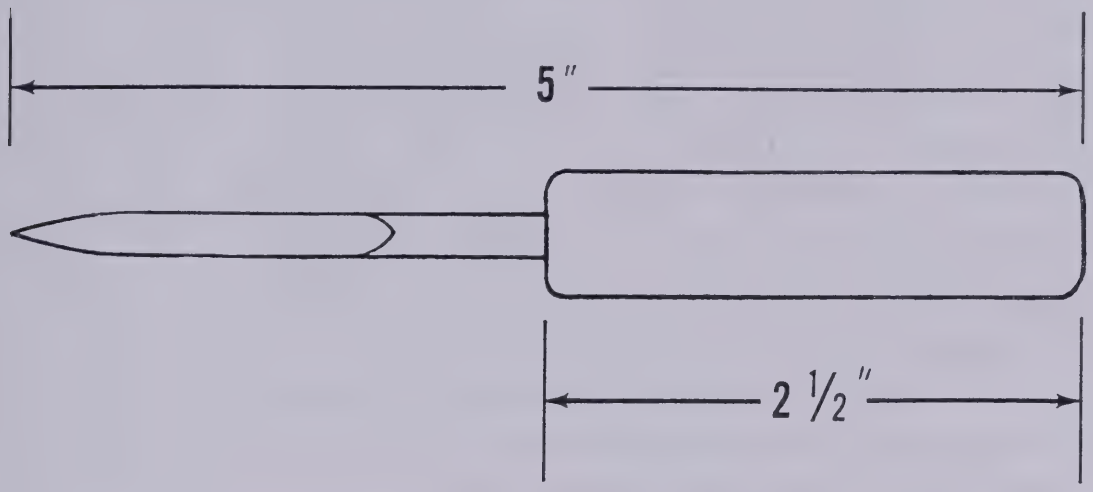


Figure 14. Plaster remover.

Section II. CLEANING, LUBRICATION, AND PAINTING

30. Cleaning and Painting

a. General. Surveying instruments, such as alidades, are cleaned and lubricated at the same time. As most alidade components and parts are hand-fitted, and threaded surfaces have such fine tolerances, it is necessary to disassemble, clean, and lubricate the alidade parts in one operation. Any attempt to lubricate without cleaning will result in damage to the delicate parts of the instrument, affecting the accuracy of its adjustments. Dirty lubricant will also result in severe binding if an attempt is made to move the components while using the alidade.

b. Lubricants. No other lubricant than that approved for use on surveying instruments will be used. Approved lubricant is noncorrosive and highly refined. Ordinary machine oil is not an approved lubricant: only watch oil should be used. The following lubricants are approved for use on alidades:

(1) OCW, Oil, Clock and Watch.

(2) GL, Grease, Aircraft and Instrument.

c. Parts Requiring Lubrication. The following is a list of parts of the alidade requiring lubrication:

(1) Telescope axle bearings.

(2) Bearing surface of clamp.

(3) Tangent and clamp plungers.

(4) Threads of tangent and clamp screws.

(5) Collar and surface of clamp.

d. Cleaning and Lubrication Intervals. Cleaning and lubrication of surveying instruments is not normally set up according to a calendar of scheduled services, as is the case with other types of equipment. With proper maintenance and careful use, an alidade can be used for years without the necessity of disassembling it for cleaning and lubrication. If inspection shows that a condition exists which can be corrected by cleaning and lubrication, the instrument must be disassembled, cleaned, and lubricated before further use, even though it has been cleaned and lubricated very recently. Cleaning and lubrication will normally be necessary when—

(1) A new or used alidade is received which has been stored under adverse conditions and an inspection discloses that binding or seizing of moving parts indicates a need for it.

(2) The condition of the alidade indicates a need for general cleaning.

(3) An inspection discloses that undue friction, binding, or maladjustment is caused by improper or insufficient lubrication.

(4) During use, binding or seizing of moving parts indicates that cleaning and lubrication are required.

(5) During shop adjustment, replacement, or repair, the instrument is disassembled; cleaning and lubrication will be performed as a standard practice in the shop.

(6) After use in coastal areas, there are evidences of corrosion due to the action of salt water and air.

e. Procedure. Cleaning and lubrication services, which require partial or complete disassembly of the alidade, will be performed in the dust-free atmosphere of an instrument repair shop and by qualified instrument repair personnel only. Taking the instrument apart under any other conditions, especially where dust might filter into the inner recesses of the alidade, will do more harm than good. Since the lubricant must be applied sparingly, never use a container with a spout, such as as oilcan, to squirt oil on parts or into assemblies. Perform (1) through (5) below when cleaning and lubricating.

(1) Wipe each surface to be lubricated with a soft, lint-free cloth.

(2) Clean gummy bearing surfaces with a cloth dampened in an approved cleaning solvent.
(3) Insert an adjusting pin (3, fig. 9) or a toothpick in a vial of watch oil and deposit one drop of oil on the surface to be lubricated.
(4) Spread the oil drop over the surface to be lubricated with the adjusting pin or toothpick.
(5) Wipe off all excess oil with a clean, dry, lint-free cloth.

Caution: Do not get any oil on the glass surfaces of lenses, leather-covered portions of the alidade, or on the under surface of the base plate.

31. Painting or Varnishing

No painting is required on the alidade itself. Screws and other exposed surfaces are covered with a baked coat of protective lacquer when the alidade is reconditioned in the instrument shop. The plane table and tripod will occasionally require cleaning, sanding, and revarnishing.

Section III. INSTRUMENTMAN PREVENTIVE MAINTENANCE SERVICES

32. General

The services described in this section include all of the preventive maintenance services for which the instrumentman is responsible while he is using the alidade in surveying operations. Those services for which the organizational maintenance personnel in the unit instrument repair shop are responsible, are described in paragraphs 40 and 41.

33. Instrumentman Inspections

The inspections in *a* and *b* below will be made by the instrumentman or the member of the survey party assigned to this duty by the party chief.

a. Before-Operation Inspection.

(1) Perform the inspection described in paragraph 8*c*.
(2) Inspect the tripods, tapes, rods, and all other surveying equipment to be sure that they are in good operating condition.
(3) At the location, and after setting up over the first point, check the level of the instrument by leveling all around to determine whether the instrument is in good operating condition or not. Do this before starting the survey. Report any deficiencies to the proper authority. Do not pro-

ceed with the survey with a faulty instrument without specific authority. Inspect the instrument adjustments (par. 19).

b. After-Operation Inspection. After returning to the base of operations, the instrumentman, or the designated survey party member, will perform the inspections listed in *a* above daily. All deficiencies noticed, which cannot be corrected immediately, will be reported to the proper authority. All deficiencies will be corrected, or arrangements will be made for the use of a substitute instrument for the next day's work.

34. Instrumentman Services

The services in *a* and *b* below will be performed by the instrumentman, or the member of the survey party assigned by the party chief to this duty.

a. Before-Operation Services.

(1) Complete the before-operation inspection prescribed in paragraph 33*a*.

(2) Check the instrument adjustments given in paragraph 19.

(3) Make the necessary operational adjustments described in paragraph 20.

(4) Check other items of equipment used in conjunction with the alidade, correcting, or reporting to the proper authority, any deficiencies noticed.

b. After-Operation Services. To be sure that the alidade will always be ready for use, the following services must be performed at the end of each day's work, and again at the end of any period of operation before putting the instrument in limited storage.

(1) Report all deficiencies to the party chief or the proper authority.

(2) Clean the exposed parts of the alidade, removing all dust, dirt, and grime. Follow the methods prescribed in paragraph 8. Do not disassemble for cleaning and lubrication unless necessary (par. 30*e*).

(3) See that all tools and equipment used in conjunction with the alidade are accounted for, in good condition, and properly stowed.

(4) Pack the alidade carefully in its carrying case. Store the instrument in a location free from vibration, moisture, humidity, tampering, and pilferage.

35. Maintenance and Safety Precautions

a. Maintenance Precautions.

(1) Report to the proper authority any mechanical deficiencies which cannot be corrected by the instrumentman or survey

party member charged with the organizational maintenance of the alidade. State in the report whether the alidade can or cannot be properly operated in its present condition. Do not recommend further use if the condition will affect the accuracy of the survey, or will result in further damage to the instrument.

(2) Never take an alidade apart in the field. Disassembly must be done only in the instrument shop under controlled conditions.

(3) Inspect the objective lens frequently to see that it has not become loose in its setting. Never take the components of any lens assembly apart in the field as this is a repair shop responsibility.

(4) Never use any unauthorized lubricant (par. 30).

(5) Never use denatured alcohol for cleaning lens surfaces, as this will leave a cloudy film on the lens. Such a film can only be removed with grain alcohol, or a lens cleaning fluid consisting of half grain alcohol and half acetone.

(6) Never leave the alidade unattended when it is out of its carrying case.

(7) Never set up the instrument without finding good footing for the tripod and spreading the legs wide.

(8) While operating the alidade do not allow clothing to come into contact with the instrument. Never touch the instrument, except at points necessary for operation.

(9) Protect the alidade against sudden jars and jolts. If such occur, report them to the proper authority. If not reported at the time, and if the alidade is not immediately checked, trouble may develop later, causing serious delay, or the results of the survey may be inaccurate due to the damage to the instrument. Vibration of travel, even over roads in good condition, has a tendency to loosen parts held by screws. Setups adjacent to heavy traffic or waterfalls, and storage in buildings which vibrate from traffic or running machinery, produce the same loosening effect.

b. Safety Precautions.

(1) Never set up on a highway or road without posting caution signs around curves, or at least 500 feet up and down the road to prevent accidents due to passing traffic.

(2) Always notify the chief of any construction project of the survey plans, so that he can protect the surveyors against injury from moving heavy equipment or blasting.

Section IV. TROUBLESHOOTING

36. Instrument Will Not Stay on Line

When the alidade drifts off line without being moved on the plane table, there are several possible causes, among which are—

a. Sunrays Striking on One Side. The expansion of metal parts due to heat from the sun's rays should be even on all parts of the alidade. If the rays are not evenly distributed, errors in operation will result. Shade the alidade from the direct rays of the sun whenever possible.

b. Vibrations. When set up near a highway carrying heavy traffic, the vibrations will affect the accuracy of the work by causing the alidade to creep or swing. Exercise care, or take the readings during periods of quiet. Setting up near a waterfall, or a building in which heavy machinery is operating, will sometimes interfere with accurate readings. Avoid such setups if possible, or make allowance for the errors in the resulting readings.

37. Lenses Fogged Internally

Sudden changes in temperatures, especially when working in areas of high humidity, will cause fogging of the internal surfaces of the lenses. Remove the eyepiece and allow warm air to circulate inside the telescope tube (par. 23).

38. Bubble Does Not Stay in Center

When the bubble moves away from the center of the vial, the cause may be one of the following:

a. Plane Table Not Level. Check the level of the plane table and correct (TM 5–232).

b. Tripod Setting Not Firm. Reset the tripod legs and tighten the tripod clamps.

c. Vial Loose in Case. Test the vial for shake.

d. Defective Vial or Jump Bubble. Replace.

39. Bubble Shakes

If the bubble shakes when the vial is touched with the finger, the cause is a faulty setting of the vial in the case. Reset the vial (par. 43).

Section V. ORGANIZATIONAL AND FIELD INSPECTION AND REPAIR

40. General

Units organized under TOE, which authorize an instrument repair section, will perform their own third echelon maintenance and

repair. Units without an instrument repair section will limit their disassembly of alidades to those procedures which can be accomplished without the use of special tools, equipment, shops, or personnel. Normally, this limitation will allow the organizational maintenance personnel to clean and lubricate the alidade, and replace only those parts which can be removed without major disassembly. In no case will organizational personnel disassemble the lens elements in a lens assembly.

41. Periodic Inspections

Instruments must be inspected, following the minimum procedure given in *a* through *h* below. Alidades are inspected when taken out of limited storage; during use at the change of a season (winter to summer); at the end of a long period of service; and at least once every six months while in limited storage. A complete technical inspection should be performed at each instance of changing the responsible officer.

a. Tools and Equipment. Inspect the condition of all tools and equipment supplied with the alidade. Check the condition of the carrying case and the mounting or stowing of the tools and accessories in the carrying case.

b. Appearance. Inspect the general appearance of the alidade, paying special attention to the cleanliness and legibility of the markings on the arcs and verniers, compass, and base plate.

c. Telescope Body. Inspect the body for dents, cracks, and damaged edges. Report defective telescope body to the proper authority.

d. Objective Lens. Inspect the objective lens for cracks, scratches, fungus etching, or dirt. Check the lens cap for proper fit. Do not take the objective lens apart. Report cracks, bad scratches, or fungus damage.

e. Reticule. Inspect the reticule for dirt or dust. Check for missing, marred, or crooked crosshairs. Report defective reticule to the proper authority.

f. Level Vials. Inspect for broken vials, loose mountings, or other damage. Replace defective vials.

g. Adjusting Screws. Inspect all adjusting screws, tangent screws, leveling screws, and capstan-head screws for good condition.

h. Deficiencies. Report all deficiencies to proper authority.

Section VI. TELESCOPE, LEVELS, AND COMPASS, Models 5093A, 5187A AND P5093A

42. Description

The telescope contains the optical elements necessary for sighting along a line of sight parallel to the fiducial edge of the base plate.

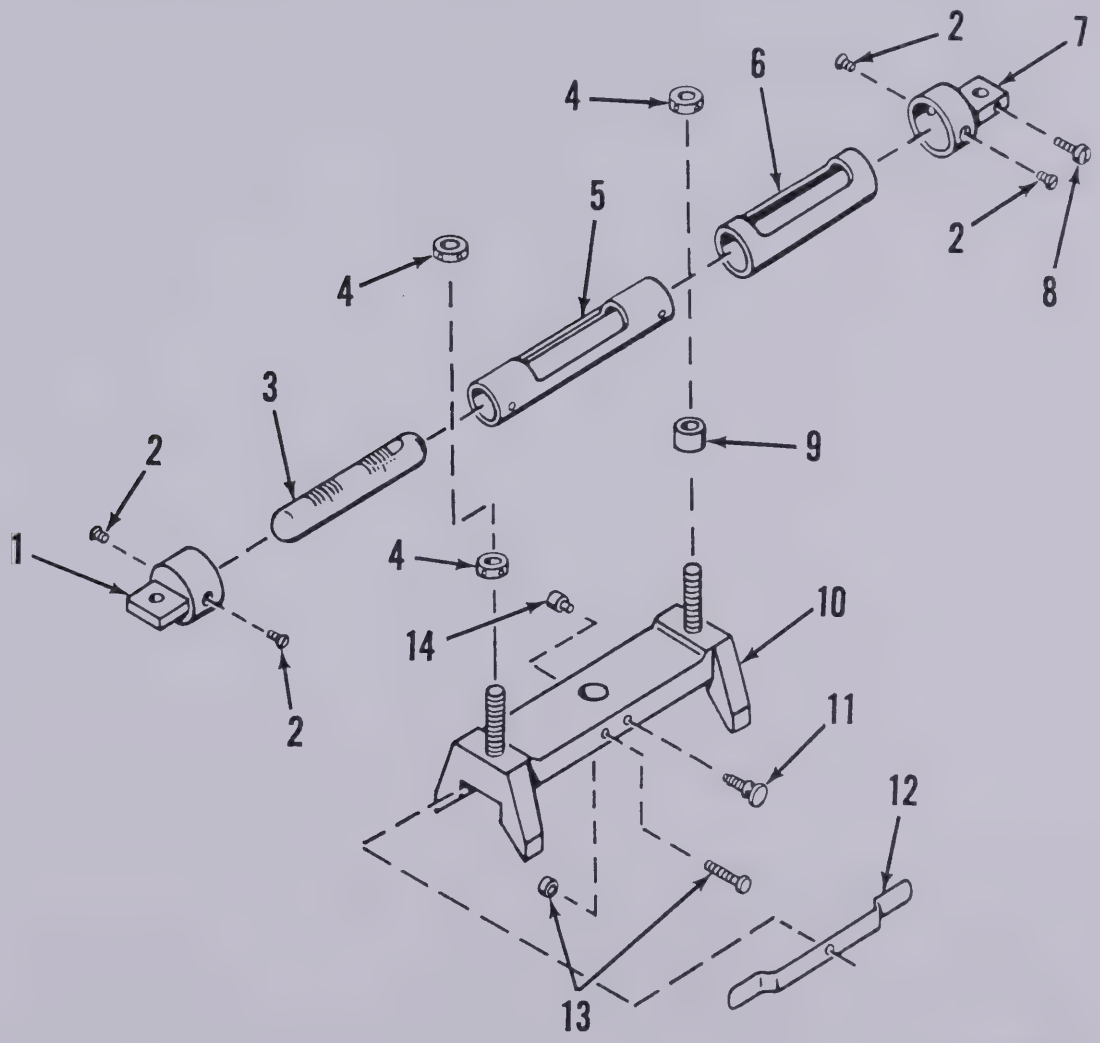
The levels determine the level position of the alidade prior to taking sight readings through the telescope. The compass mounted on the base plate indicates the approximate alinement of the base plate and the line of sight of the telescope.

43. Striding Level

a. Removal and Disassembly.

(1) Back off the striding level lock screw (11, fig. 15) ; push in on the bubble bracket plunger screw (13), and lift the striding level from the striding level stud (2, fig. 7).

(2) Remove the striding level lock screw (11, fig. 15). Invert the striding level, place a small screwdriver blade in the



EMC 6600-15

1 Tube end, adjustable
2 Tube end retaining screw (4 rqr)
3 Level vial
4 Locknut (3 rqr)
5 Level vial tube
6 Level vial cover
7 Tube end, fixed
8 Striding level adjusting screw (2 rqr)
9 Spacer nut
10 Striding level bracket
11 Striding level lock screw
12 Plunger screw spring
13 Bubble bracket plunger screw (w/nut)
14 Plunger spring setscrew

Figure 15. Striding level, telescopic alidade, models 5093A, P5093A and 5187A, exploded view.

opening in the bracket plunger screw collar nut (13), and turn the bracket plunger screw (13) until free. Remove the bracket plunger screw (13) from the striding level bracket (10) and lift out the nut (13).

(3) Remove the plunger spring setscrew (14) and lift out the plunger screw spring (12). Place the striding level bracket assembly in an upright position.

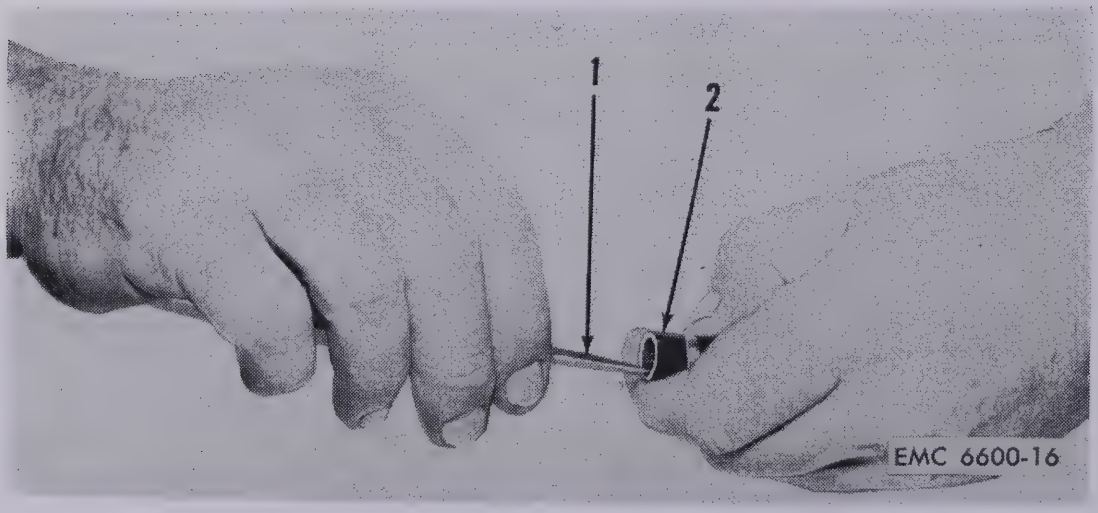
(4) Remove the fixed end locknut (4) with an adjusting pin (3, fig. 9). Remove the adjustable end locknut (4, fig. 15) with an adjusting pin. Remove two striding level adjusting screws (8) and lift the level vial tube (5) and cover (6) assembly from the striding level bracket (10).

(5) Remove the bottom locknut (4) from the adjustable end stud, and the spacer nut (9) from the fixed end stud.

(6) Remove the four tube end retaining screws (2). Remove the fixed tube end (7) by placing adjusting pins in the tube end post holes and twisting the pins in opposite directions. Mark the inside of the fixed tube end (7). Slide off the level vial cover (5). Remove the adjustable tube end (1).

(7) Using the cutting edge and sharp point of the cutting tool (fig. 14), carefully remove the plaster-of-paris from one end of the level vial tube (5, fig. 15). Work carefully so as not to break the level vial (3) or damage the vial tube (5). See figure 16 for correct way to hold cutting tool and level vial tube. Remove the plaster-of-paris from the other end of the level vial tube (5, fig. 15).

(8) Tap the end of the level vial tube (5) with a soft-faced hammer until the level vial (3) begins to move in the level



1 Cutting tool 2 Level vial tube

Figure 16. Removing plaster-of-paris from level vial tube.

vial tube (5). Scrape out the remaining plaster-of-paris from the end of the tube the vial has moved away from.

Caution: Do not strike the pointed tip on one end of the level vial.

Insert the eraser end of a pencil in the other end of the level vial tube (5) and carefully push the level vial (3) out at the cleaned end of the level vial tube (5). Carefully scrape out the rest of the plaster-of-paris and paper bearing from the inside of the level vial tube (5).

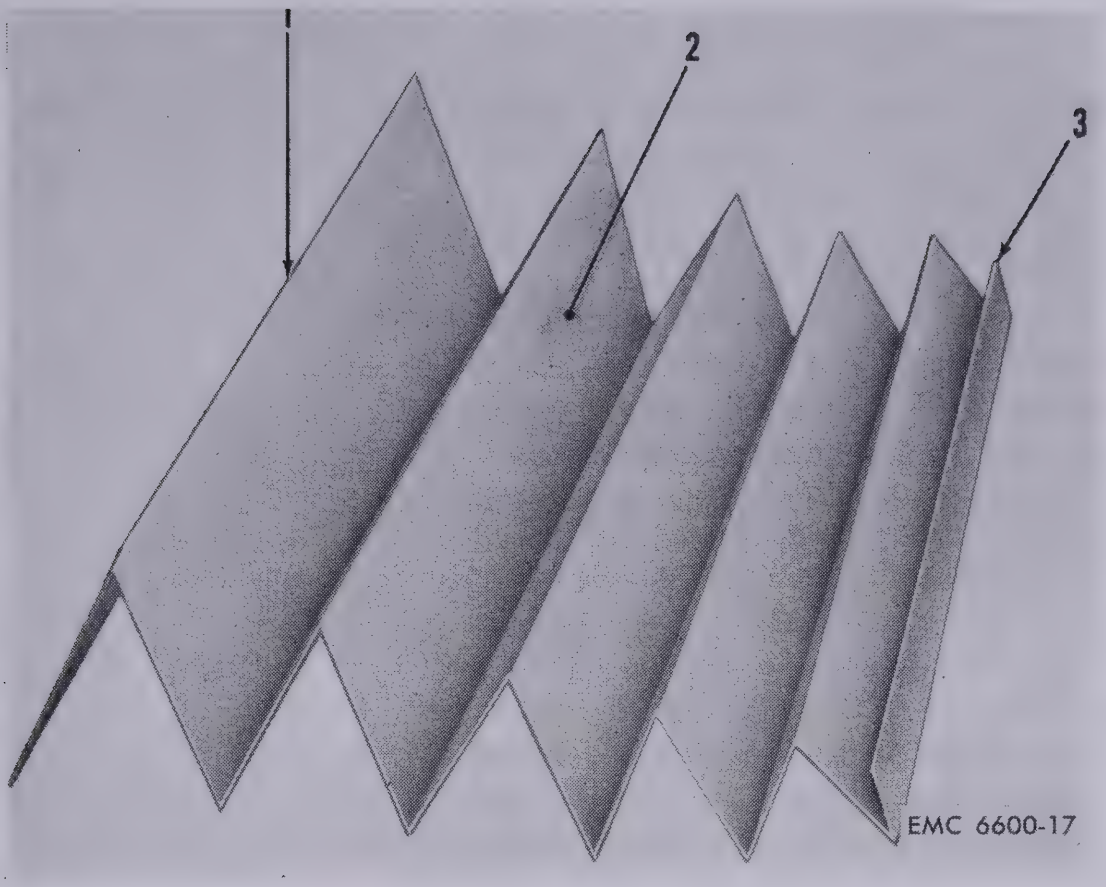
b. Cleaning, Inspection, and Repair. Clean all parts with approved cleaning solvent. Inspect all studs, screws, and nuts for worn or damaged threads. Check the striding level bracket (10, fig. 15) for cracks, bends, and breaks. Straighten bent bracket or replace if badly bent or otherwise defective. Inspect the tube ends (1 and 7) for burs, bends, and cracks. Smooth out burs and straighten minor bends. Replace defective tube ends. See that the level vial cover (6) turns smoothly on the level vial tube (5). Remove burs and straighten bends on level vial cover and level vial tube. Replace defective cover and tube. Check the plunger screw spring (12) for bends and fatigue. Remove bends from spring or replace if defective. Check the level vial for cracks, scratches, and illegible markings. Replace defective vial.

c. Reassembly and Installation.

(1) Before replacing the level vial (3), prepare a bearing from stiff, white paper. The paper bearings acts as a light-reflecting surface and allows for contraction and expansion of the level vial as the result of changes in temperature. Cut the paper so it is longer than the vial, but not so long that it interferes with the proper insertion of the tube ends in the level vial tube. Make the large fold (1, fig. 17) so that it fits the inside circumference of the level vial tube (5, fig. 15) without projecting into the opening in the tube where the level vial (3) will be read by the instrumentman.

(2) Make each succeeding fold narrower than the last and continue until it is felt that the bearing is thick enough to hold the level vial (3) snugly in the level vial tube (5). Compress the bearing (2, fig. 17) into a trough and lay the level vial in the trough formed by the large fold (1). Insert the bearing and vial into the level vial tube and check for snug fit. If the bearing and vial will not go into the tube, cut off the small fold (3) and try again. Remove enough of the folds of the bearing, from the small end, so that the bearing and vial fit the vial tube snugly.

(3) Prepare a plaster-of-paris and water solution of medium thickness. Center the markings on the level vial (3, fig.15)



1 Large fold 2 Paper bearing 3 Small fold

Figure 17. Correct folding of paper bearing for level vial.

in the opening in the level vial tube (5), and fill one end of the tube with the plaster-of-paris solution, leaving enough room so that the tube end will fit. When the plaster hardens slightly, repeat the process at the other end of the vial tube. Let the vial and tube assembly sit for one hour before attempting to install the tube ends.

Note. If moisture gets into the vial tube in the field, the paper bearing may become brown or discolored. If the level reading can still be made, it is not necessary to replace the level vial bearing, even though it is discolored.

(4) Insert the adjustable tube end (1, fig. 15) in the level vial tube (5) and turn to aline the holes in the tube end and vial tube. Install the two tube end retaining screws (2). Slide the level vial cover (6) over the free end of the level vial tube (5) and check to see that it turns smoothly. Install the fixed tube end (1) and two tube retaining screws (2).

(5) Place the striding level bracket (10) in an upright position. Place the spacer nut (9) on the fixed end stud in the striding level bracket (10), and the bottom locknut (4) on the adjustable end stud. Carefully slide the level vial (3) as-

sembly over the studs, so as not to damage the stud threads, and making sure that the tube ends (1 and 7) are resting on the proper studs in the striding level bracket (10). Place the top locknuts (4) on the fixed end and adjustable end studs. Place the two striding level adjusting screws (8) in the adjustable tube end.

(6) Invert the striding level bracket (10) and position the plunger screw spring (12) in the underside of the bracket. Press the spring (12) against the bracket and aline the hole in the spring with the one in the side of the bracket. Screw the plunger spring setscrew (14) into the plunger screw spring (12) from the outside.

(7) Position the bubble bracket plunger nut (13) in the underside of the striding level bracket (10). Insert the bubble bracket plunger screw (13) through the side of the striding level bracket (10) and, holding the nut with a screwdriver, screw the bubble bracket plunger screw (13) into the nut. Install the striding level lock screw (11).

(8) Push in on the bubble bracket plunger screw (13) and slide the striding level over the striding level stud (2, fig. 7) on the top of the telescope. Release the bubble bracket plunger screw (13, fig. 15) and tighten the striding level lock screw (11), securing the striding level assembly to the telescope.

44. Dust Cap, Sunshade, Objective Lens, and Prism

a. Removal.

(1) Pull the dust cap (1, fig. 2) or sunshade (2) from the objective lens (5) assembly. In some alidades the sunshade fits over the objective lens and the dust cap can be fitted onto the sunshade, but this is not possible with the models 5093A and 5187A.

(2) Unscrew the objective lens (5) assembly from the end of the telescope.

Note. Do not attempt to disassemble the objective lens assembly.

(3) If the prism (1, fig. 9) is mounted on the telescope, unscrew and remove it, and replace the eyepiece cap (3, fig. 1) on the telescope.

b. Cleaning and Inspection.

(1) Clean the dust cap (1, fig. 2) and sunshade (2) with a soft rag dampened in approved cleaning solvent. Clean the objective lens (5) and prism (1, fig. 9) according to paragraph 8*d*.

(2) Check the dust cap and sunshade for bends, cracks, and

breaks. Straighten minor bends or replace defective dust cap and sunshade.

(3) Inspect the objective lens assembly and prism for cracked or broken housings, scratches on lens and prism, and fungus etching. Replace defective objective lens and prism, or report condition to the proper authority.

c. Installation.

(1) Screw the objective lens (5, fig. 2) assembly into the end of the telescope. Either install the prism (1, fig. 9) in its mounting in the carrying case, or remove the eyepiece cap (3, fig. 1) from the small end of the telescope and screw the prism assembly onto the telescope. Store the eyepiece cap in a secure place while the prism is mounted on the telescope.

(2) Install the dust cap (8, fig. 2) over the objective lens (5) and place the sunshade (2) in its mounting in the alidade carrying case body (12, fig. 9). If the sunshade is to be put on the alidade, store the dust cap in a secure place until needed.

45. Telescope

a. General. If the telescope is removed from the alidade, it makes for easier access to other components of the instrument which may have to be removed and serviced. Early removal of the telescope lessens the chance of damaging it while working on other components.

b. Removal.

(1) Remove the striding level (par. 43*a*).

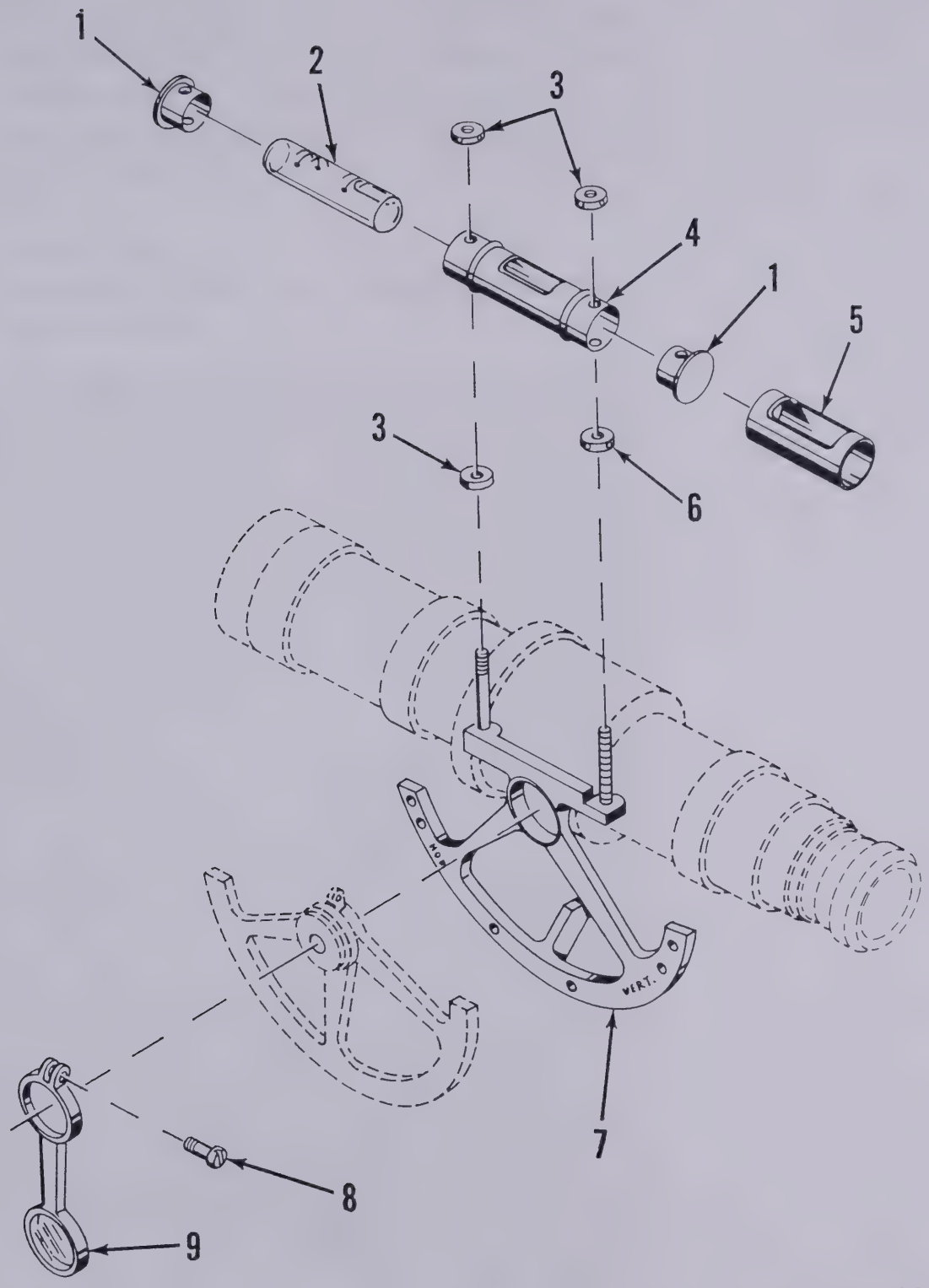
(2) Unscrew the telescope lock ring (17, fig. 2). Grasp the front end of the telescope tube (7, fig. 1) and pull it from the axle mounting. Cover the ends of the telescope with dust- and lint-free material and lay it to one side in a secure place.

c. Cleaning and Inspection. Clean the lenses with lens tissue or a camel's hair brush. Wipe the telescope body with a soft cloth moistened in approved cleaning solvent. Inspect the telescope for visual evidences of damage. Report defective or damaged telescope to the proper authority.

d. Installation.

(1) Insert the telescope tube in the axle from the front and turn the tube until it is seated in position.

(2) Screw the telescope lock ring (17, fig. 2) onto the axle, locking the telescope to the axle.



EMC 6600-18

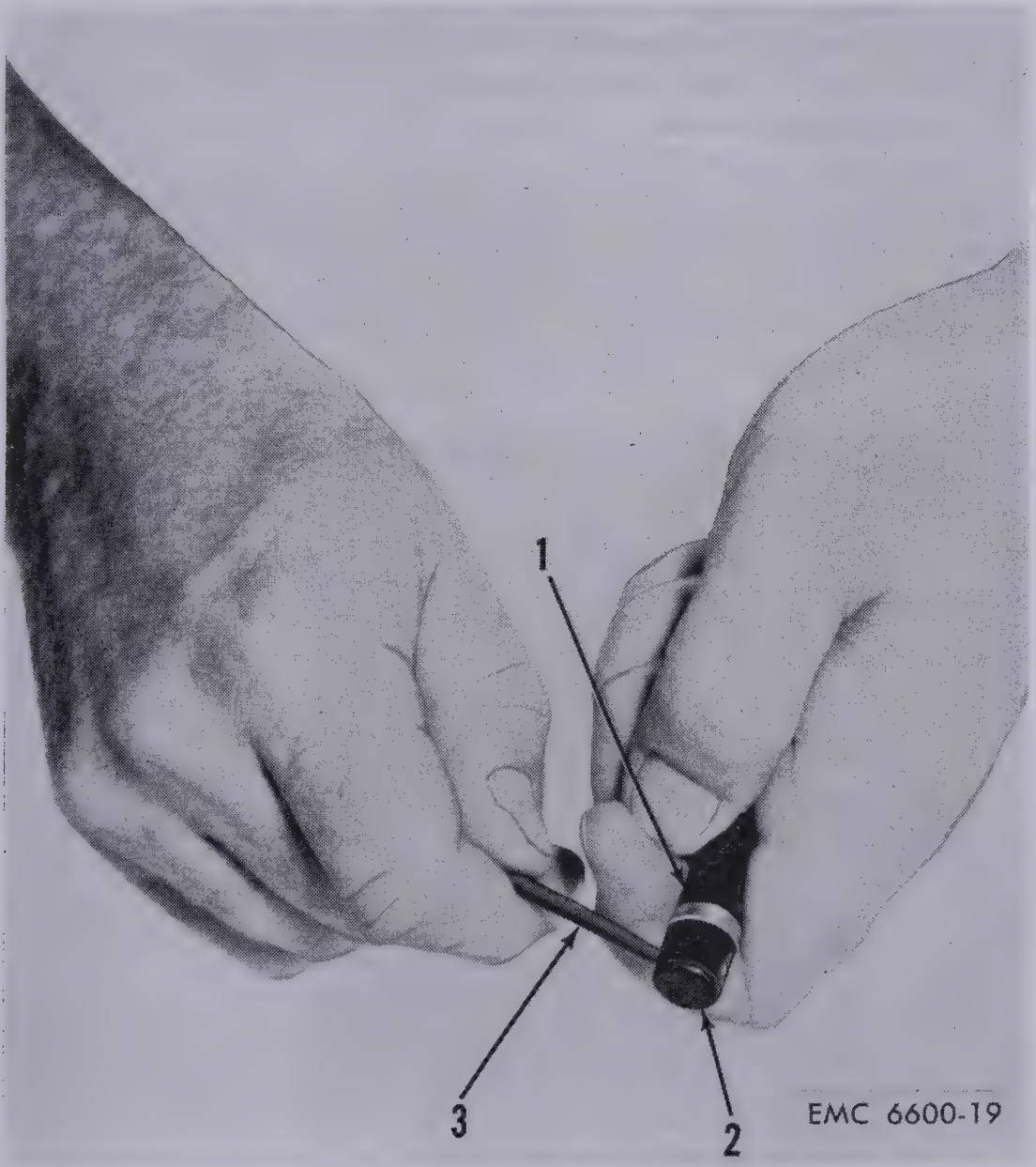
1 Tube end, adjustable
2 Level vial
3 Rocker nut (3 rqr)
4 Level vial tube
5 Level vial cover
6 Rocker washer
7 Vernier arc
8 Magnifier screw
9 Telescope indice magnifier

Figure 18. Magnifier and control level, exploded view.

a. General. The magnifier (9, fig. 18) is used to enlarge the figures on the vertical arc (10, fig. 2), indice (11), and vernier (14) and make them easier for the instrumentman to read. The magnifier is mounted on a swivel which is fastened to the axle by the axle rosette (13). The control level (7), mounted on the vernier arc, is used to level the plane table. Two types of control levels may be found on the telescopic alidade. The alternate control level is described in paragraph 47.

b. Removal and Disassembly.

(1) Remove the magnifier screw (8, fig. 18) and lift the magnifier (9) from the alidade.



1 Level vial tube 2 Tube end 3 Adjusting pin

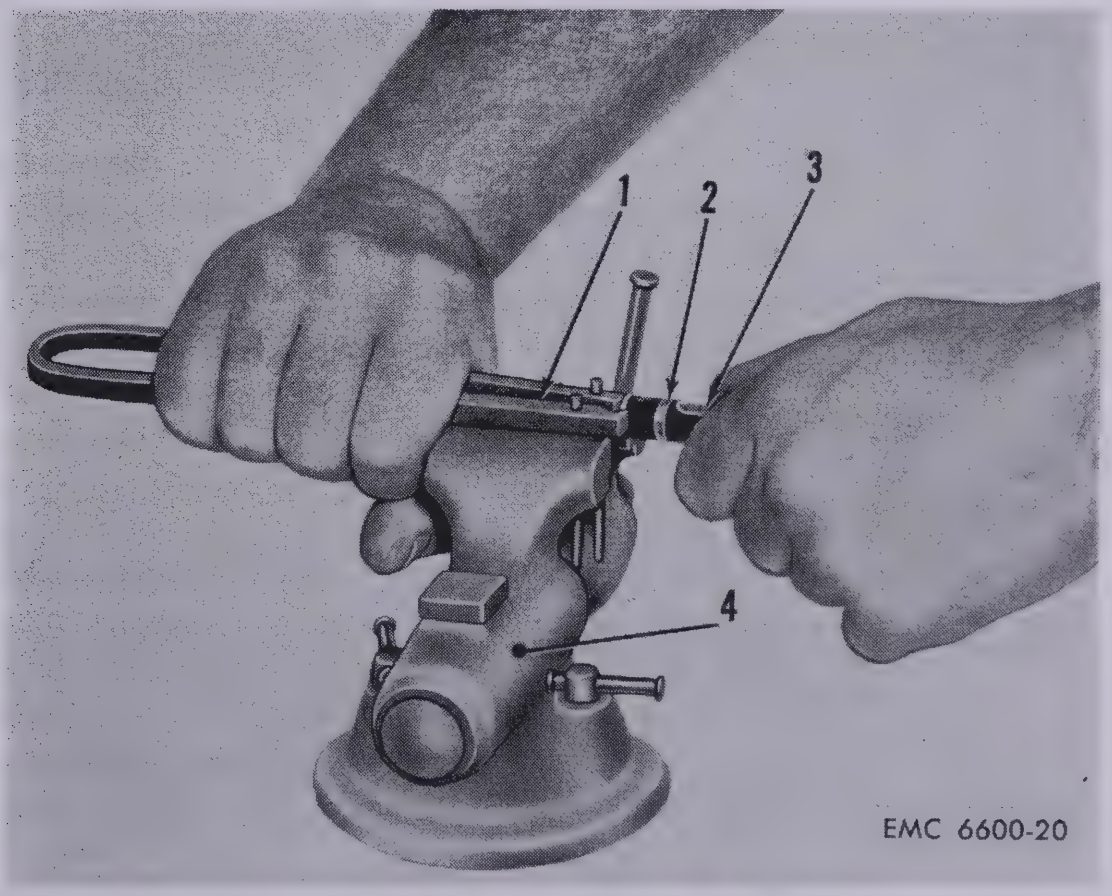
Figure 19. Loosening tube end from level vial tube.

(2) Remove the two top rocker nuts (3) from the vernier arc assembly (7) studs with an adjusting pin. Lift the control level from the studs. Remove the rocker nut (3) from the adjustable end stud, and the rocker washer (6) from the fixed end stud.

(3) Hold the level vial tube (1, fig. 19) in one hand and, with an adjusting pin (3) inserted about one-eighth inch in the post hole of the tube end (2), press downward and loosen the tube end from the level vial tube. Be careful not to damage the level vial tube (1) or tube end (2) by exerting too great a downward pressure.

(4) With a screwdriver inserted in the loosened joint, push the tube end (2) from the level vial tube (1). If the tube end cannot be removed from the level vial tube with a screwdriver, make a puller from a piece of bar stock (fig. 13).

(5) Place the pulling tool (1, fig. 20) in a vise (4) and contract the tool with the vise jaws until the puller jaws are around the collar on the tube end (2). Hold the puller with one hand and work the level vial tube (3) free from the tube end (2) with the other hand.



1 Pulling tool
2 Tube end
3 Level vial tube
4 Vise

Figure 20. Removing tube end from level vial tube.

(6) For removal of the level vial (2, fig. 18) from the level vial tube (4), refer to paragraph 43*a*(7) and (8).

c. Cleaning, Inspection, and Repair.

(1) Clean all metal parts with approved cleaning solvent. Clean the magnifier lens with lens tissue.

(2) Inspect the magnifier (9) for cracked or broken frame, burs, and bends. Smooth out burs with a hand stone and straighten minor bends. Check the magnifier lens for cracks, scratches, and etching. Replace defective magnifier.

(3) For inspection and repair of the control level assembly, refer to paragraph 43*b*.

d. Reassembly and Installation.

(1) Replace the rocker washer (6) on the fixed end stud, and the bottom rocker nut (3) on the adjustable end stud. Tighten with an adjusting pin.

(2) Replace the level vial (2) in the level vial tube (4) (par. 43*c*(1), (2), and (3)). Tap the tube ends (1) into the level vial tube (10).

(3) Slide the level vial assembly over the studs in the vernier arc assembly (7, fig. 18). Replace the top rocker nuts (3) on the fixed end stud and adjustable end stud, and tighten with an adjusting pin.

47. Alternate Control Level

a. General. The alternate control level differs from the one described in paragraph 46 in the adjustable tube end (7, fig. 21), and the mounting screws (4 and 5). Its function, in connection with the operation of the telescopic alidade, is the same as the control level described in paragraph 46.

b. Removal and Disassembly.

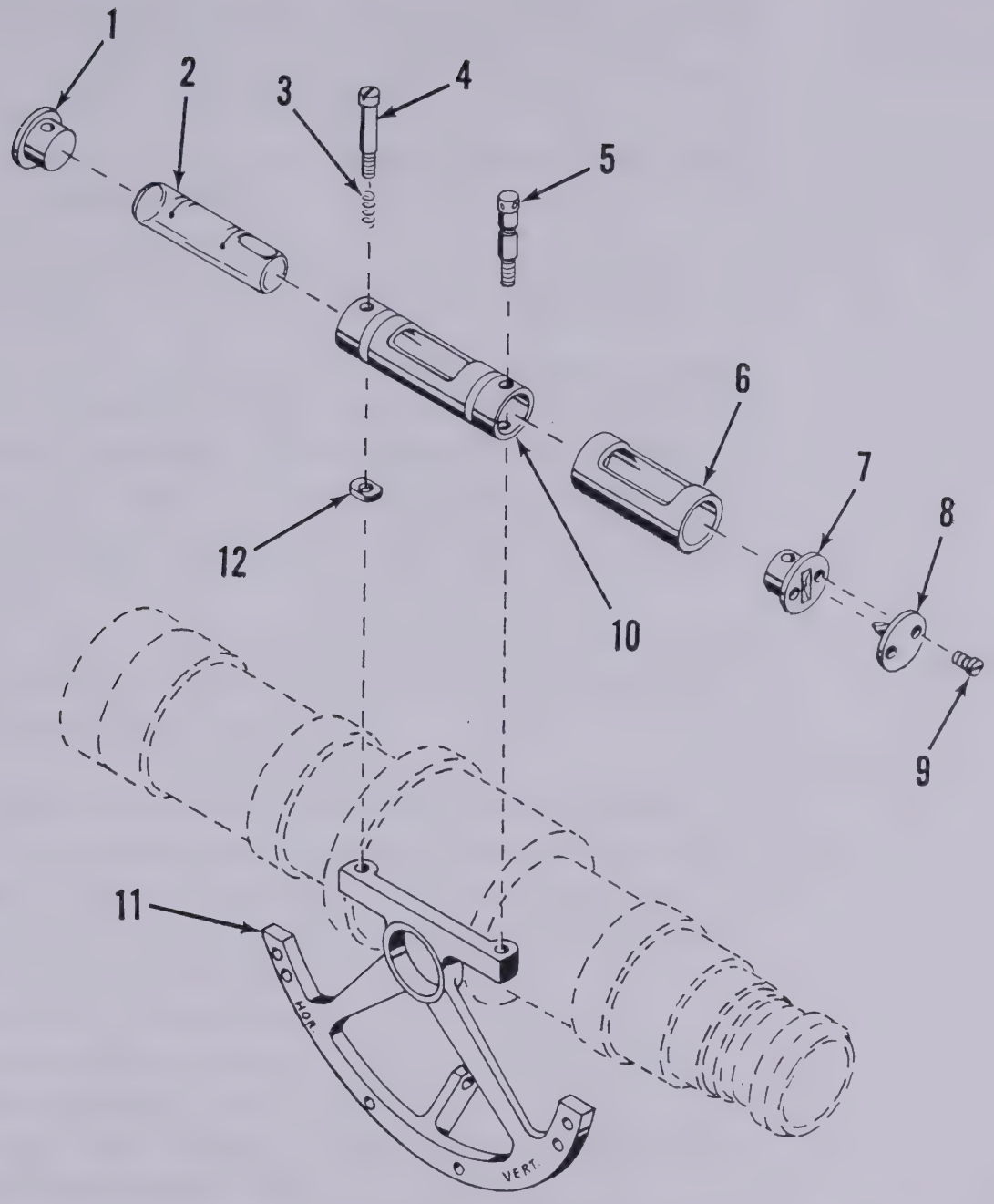
(1) Remove the magnifier (par. 46*b*(1)).

(2) Remove the two tube end disk pin retaining screws (9, fig. 21). Lift off the disk pin (8).

(3) Remove the adjustable end screw (5) with an adjusting pin (3, fig. 9). Remove the fixed end screw (4, fig. 21) with a screwdriver and lift out the fixed end spring (3).

(4) Remove the vial (2) assembly and fixed end washer (12) from the vernier arc (11). Remove the tube ends (par. 46*b*(3), (4), and (5)).

Note. The level vial cover (6, fig. 21) cannot be removed from the level vial tube (10) until one of the tube ends (1 or 7) has been removed from the level vial tube.



EMC 6600-21

1	Tube end, fixed	7	Adjustable tube end
2	Level vial	8	Tube end disk pin
3	Fixed end spring	9	Tube end disk pin screw (2 rqr)
4	Fixed end screw	10	Level vial tube
5	Adjustable end screw	11	Vernier arc
6	Level vial cover	12	Fixed end washer

Figure 21. Alternate control level assembly, exploded view.

(5) Remove the level vial (2) from the level vial tube (10), paragraph 43*a*(7) and (8).

c. Cleaning, Inspection, and Repair.

(1) Clean all parts with approved cleaning solvent.

(2) Inspect the fixed end spring (3, fig. 21) for breaks and fatigue. Replace defective spring. Check the disk pin (8)

for cracks and breaks. Replace defective disk pin. Inspect the fixed end screw (4) and adjustable end screw (5) for damaged threads, burs, and wear. Replace defective screws.

(3) For cleaning, inspection, and repair of the remaining parts, refer to paragraph 46*c*.

d. Reassembly and Installation.

(1) Place the level vial (2) in the level vial tube (par. 43*c*(1), (2), and (3)).

(2) Place the fixed end washer (12, fig. 21) over the mounting hole in the vernier arc (11). Aline the mounting holes in the level vial assembly with the mounting holes in the vernier arc (1). Insert the fixed end spring (3) and screw (4) in the mounting holes and partially tighten the fixed end screw. Install the adjustable end screw (5). Tighten both screws.

(3) Aline the tube end disk pin (8) with the adjustable tube end (7) and install the two tube end disk pin screws (9).

(4) Install the magnifier (par. 46*d*).

48. Base Plate Knobs, Base Plate Level, and Trough Compass

a. General. The base plate knobs (1, fig. 22) are used to remove the alidade around on the working surface. The base plate level (4) is used to determine whether the alidade is level or not. The trough compass (2) is used to determine direction.

b. Removal and Partial Disassembly.

(1) Remove the striding level (par. 43*a*).

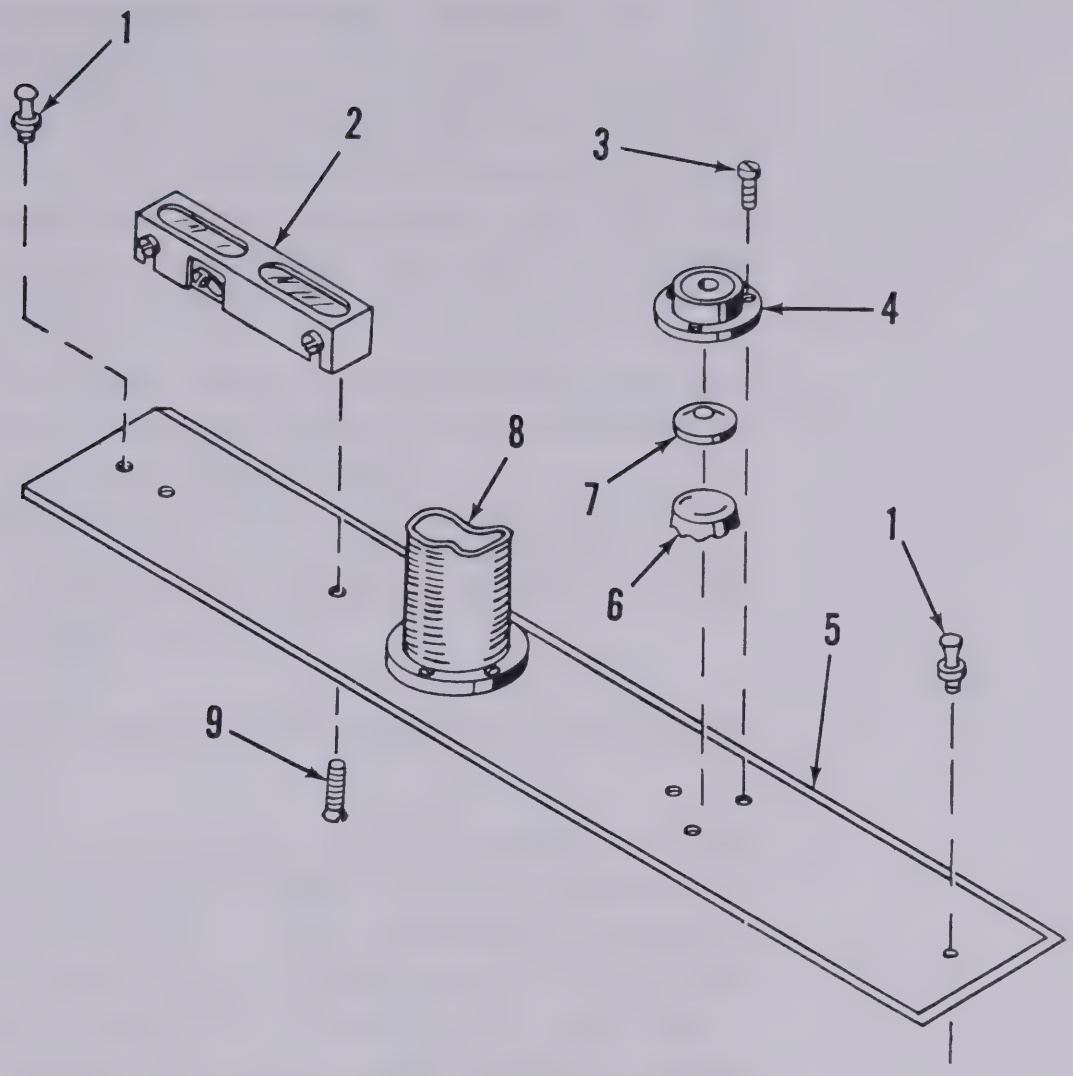
(2) Remove the telescope (par. 45*b*).

(3) Remove the three screws (3) and lift the base plate level (4) from the base plate (5).

(4) Remove the two base plate knobs (1) from the base plate (5), using a pair of pliers. Cover the plier jaws with cloth or other suitable material so that the knobs will not be burred.

(5) Lay the alidade on its right side with the base plate (5) facing the edge of the working surface. Remove the two countersunk screws (9) and lift the trough compass (2) from the base plate.

c. Cleaning and Inspection. Clean all metal parts with approved cleaning solvent. Wipe the trough compass (2) and base plate level with a cloth moistened with cleaning solvent. Polish the compass and level glasses with lens tissue. Check threaded parts for worn or damaged threads. Replace defective base plate knobs (1) and



EMC 6600-22

1 Base plate knob (2 rqr)
2 Trough compass
3 Screw, fil hd, $\frac{3}{16}$ NF (3 rqr)
4 Base plate level
5 Base plate
6 Plaster-of-paris
7 Level vial
8 Alidade pedestal
9 Screw, flat, cs hd, $\frac{3}{16}$ NF (2 rqr)

Figure 22. Base plate components, partially exploded view.

screws (3 and 9). Inspect the base plate level for cracked or broken glass, defective level vial (7), and vial mounting in the bottom. If the plaster-of-paris mounting is broken, or the vial (7) needs to be replaced, remove the plaster-of-paris and vial, and clean out the level mounting. Check the trough compass (2) for cracked or broken glass, defective needle, and pivot. Replace defective compass.

d. Reassembly and Installation.

(1) Put the vial (7) in the base plate level (4) housing and shim it in the housing tightly with split paper match stems, or other suitable material. Make sure the base plate (5) is level. Aline the base plate level (4) mounting holes with the mounting holes in the base plate. If the vial bubble is not centered, turn the level over and adjust the shims.

Repeat the process until the bubble is centered. Pour sufficient plaster-of-paris in the bottom to secure the vial firmly. Let dry for an hour, scrape off the excess plaster, aline the holes of the level and base plate, and install the three screws (3). If the bubble is not centered after the screws are tightened, loosen the screws, and slide thin shims between the level and the base plate. Tighten the screws and check the bubble. Repeat the process until the bubble is centered.

(2) Install the base plate knobs (1) in each end of the base plate. Tighten with a pair of pliers. Cover the plier jaws so as not to bur the base plate knobs (1).

(3) Lay the alidade on its right side. Place the trough compass (2) on the top side of the blade and aline the mounting holes. Install the two countersunk screws (9) in the bottom of the base plate (5).

Section VII. TELESCOPE, LEVELS, AND COMPASS, MODEL P5093A

49. General

a. Description. The telescopic alidade, model P5093A, functions the same as the model 5093A and is similar as far as operating and control components are concerned. It has a light finish as opposed to the dark finish on the 5093A model. The dust cap (10, fig. 3) and sunshade (1) can both be fitted on the telescope at the same time.

b. Compass. The P5093A model has a damp-inducted compass (6, fig. 3), as opposed to the trough compass (2, fig. 1) found on the 5093A model.

c. Bearing Bracket. The vernier arc (5, fig. 3) fits over a bearing bracket (7), which is secured to the standard by screws.

d. Lenses and Eyepiece. The P5093A model has coated lenses and the composition of the eyepiece (4) is different from that in the 5093A model, but both operate the same.

50. Damp-Inducted Compass

a. Removal.

(1) Remove the striding level (par. 43*a*).

(2) Remove the telescope (par. 45*b*).

(3) Remove the objective lens (par. 44*a*), magnifier (par. 44*b*), and control level (par. 46*b* or 47*b*), if necessary. It is not necessary to remove these components to work on the compass.

(4) Remove the base plate level (8) and base plate knobs (9) (par. 48*b*).

(5) Remove the damp-inducted compass (6) (par. 48*b*).

b. Cleaning and Inspection.

(1) For cleaning and inspection of the base plate level and base plate knobs, and cleaning of the damp-inducted compass, see paragraph 48*c*.

(2) Place the compass (6, fig. 3) on a flat, level surface. Operate the compass level and see if the compass needle is held securely when the lever is in the down position, and floats freely when the lever is in the upright position. Inspect the needle to see if it is in level balance when free. If there is any doubt about the sensitivity of the needle, perform the following test:

(*a*) Center the needle and draw a line along the edge of the blade of the alidade base plate.

(*b*) Swing the blade off this line.

(*c*) Re-center the needle.

(*d*) After the needle is centered, if the blade is not parallel to its original position, the compass is defective. If the needle is not level, or the above test is not satisfactory, replace the compass assembly, or report the condition to the proper authority.

c. Reassembly.

(1) Install the compass assembly (par. 48*d*).

(2) Install the base plate level (8, fig. 3) and base plate knobs (9) (par. 48*d*).

(3) Install the telescope (par. 45*d*).

(4) Install the striding level (par. 43*c*).

Caution: Components and most parts of telescopic alidades, model 5093A and 5187A, and 5093A, are not interchangeable due to the fact that the majority of components and parts are hand-fitted to each individual alidade. Occassionally, the bearing bracket (7, fig. 3) may be found on a model 5093A alidade.

(4) Aline the magnifier (9, fig. 18) mounting holes with the mounting holes in the swivel and replace the magnifier screw (8).

Section VIII. LEVELS AND COMPASS, MODELS 5095A, 5189A, AND P5095A

51. General

a. Models 5095A and 5189A. Models 5095A and 5189A are miniature telescopic alidades which are smaller and lighter than telescopic alidades. The telescope standard (6, fig. 4) is fastened

directly to the base plate (16, fig. 5), instead of being mounted on a pedestal (12, fig. 1) as the telescopic alidades are. The striding level (4, fig. 4) is not carried in the carrying case (fig. 10), but is mounted on the striding level stud (12, fig. 4) when not mounted on the telescope for use. Both trough compasses (1) and damp-inducted compasses (10, fig. 6) may be found on miniature telescopic alidade, models 5095A and 5189A. The prism assembly (2, fig. 4) on models 5095A and 5189A are not removed at organizational level. The dust cap (1, fig. 5), sunshade (2), and objective lens (3) are removed and serviced exactly as are those in paragraph 44. The telescope (5, fig. 4) is handled the same as the one described in paragraph 45. The magnifier (12, fig. 5) and the control level (4) are serviced according to instructions in paragraph 46.

b. Model P5095A. Maintenance, at organizational level, on the Model P5095A miniature telescopic alidade is identical with that described in this section for models 5095A and 5189A, except that model P5095A is always equipped with a damp-inducted compass. Maintenance of the damp-inducted compass is covered in paragraph 50.

52. Striding Level

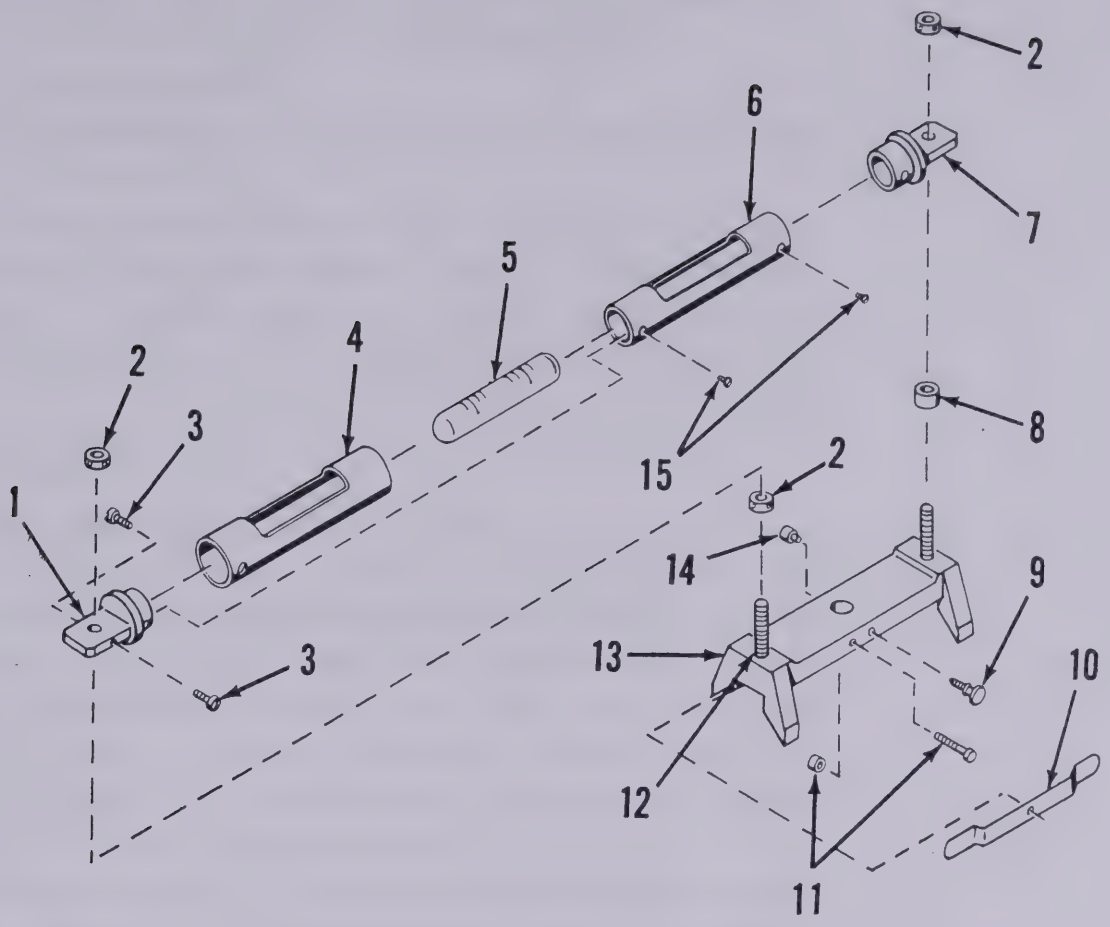
a. Removal and Disassembly.

(1) Back off the striding level lock screw (9, fig. 23), push in on the bubble bracket plunger screw (11), and lift the striding level from the striding level stud (9, fig. 6), if the level is mounted on the base plate. If the striding level is mounted on the telescope (5, fig. 4), lift it from the striding level stud (2, fig. 7).

(2) Remove the striding level lock screw (9, fig. 23). Invert the striding level. Place a screwdriver against the bubble bracket plunger screw collar (11) to lock it, and unscrew the bubble bracket plunger screw (11). Lift out the collar (11).

(3) Remove the plunger spring setscrew (14) and lift out the plunger screw spring (10). Place the striding level bracket (13) assembly in an upright position.

(4) Remove the fixed end locknut (2) with an adjusting pin (6, fig. 10). Remove the adjustable end locknut (2, fig. 23) with an adjusting pin. Remove the two fixed end lock screws (3) and lift the level vial assembly from the striding level bracket (13). Remove the bottom locknut (2) from the adjustable end stud, and the spacer nut (8) from the fixed end stud.



EMC 6600-23

1	Fixed tube end	9	Striding level lock screw
2	Nut, round, $\frac{7}{16}$ OD (3 rqr)	10	Plunger screw spring
3	Screw, winding (2 rqr)	11	Bubble bracket plunger screw and collar
4	Level vial cover	12	Stud
5	Level vial	13	Striding level bracket
6	Level vial tube	14	Plunger spring setscrew
7	Adjustable tube end	15	Screw, tube end retaining (4 rqr)
8	Nut, round, $\frac{7}{16}$ OD, ¼ T		

Figure 23. Striding level, model 5095A, P5095A, and 5189A alidades, exploded view.

(5) Turn the level vial cover (4) until the hole in the fixed end is alined with the tube end retaining screw (15) seated in the level vial tube (6). Remove the screw (15). Turn the level vial cover (4) and aline the hole with the screw seated in the other side of the level vial tube (6). Remove the second screw (15).

(6) Match-mark the tube ends (1 and 7). Insert adjustable pins in the tube end (1 and 7) post holes and twist in opposite directions to remove the tube ends from the level vial tube (6). Slide the level vial cover (4) off the level vial tube (6).

(7) Remove the level vial (5) from the level vial tube (6) (par. 43*a*(7) and (8)).

b. Cleaning, Inspection, and Repair. For cleaning, inspection, and repair of the striding level, refer to paragraph 43*b*.

c. Reassembly and Installation.

(1) Install the level vial (5) in the level vial tube (6) (par. 43*c*(1), (2), and (3)).

(2) Insert the adjustable tube end (7) in the level vial tube (6), alining the match marks. Secure the adjustable tube end (7) to the level vial tube (6) with two tube end retaining screws (15). Slide the level vial cover (4) over the free end of the level vial tube (6) with the alining hole in the end of the cover at the free end of the level vial tube.

(3) Insert the fixed tube end (1) in the level vial tube (6), alining the match marks. Turn the level vial cover (4) until the hole at the fixed end is alined with the mounting holes in the tube end (1) and level vial tube (6). Install a tube end retaining screw (15). Turn the level vial cover (4) until the hole in the cover is alined with the mounting holes on the other side of the assembly. Install a second tube end retaining screw (15).

(4) Install the spacer nut (8) on the fixed end stud, and the bottom locknut (2) on the adjustable end stud. Install the level vial assembly on the striding level bracket (13) studs. Install the two top locknuts (2) and tighten with an adjusting pin. Install the two tube winding screws (3).

(5) Invert the striding level bracket (13) and position the plunger screw spring (10) in the underside of the bracket. Press the spring (10) against the bracket and aline the hole in the spring with the one in the side of the bracket. Screw the plunger spring setscrew (14) into the plunger screw spring (10) from the outside.

(6) Position the bubble bracket plunger screw collar (11) in the underside of the striding level bracket (13). Insert the bubble bracket plunger screw (11) through the side of the striding level bracket (13) and, locking the collar (11) in place with a screwdriver, screw the bubble bracket plunger screw into the collar. Install the striding level lock screw (9).

(7) Push in on the bubble bracket plunger screw (11) and slide the striding level over the striding level stud (9, fig. 6) or (2, fig. 7). Release the bubble bracket plunger

screw (11) and tighten the striding level lock screw (9), securing the striding level assembly to the stud.

53. Base Plate Knobs, Base Plate Level, Trough Compass, and Striding Level Mount

a. Removal.

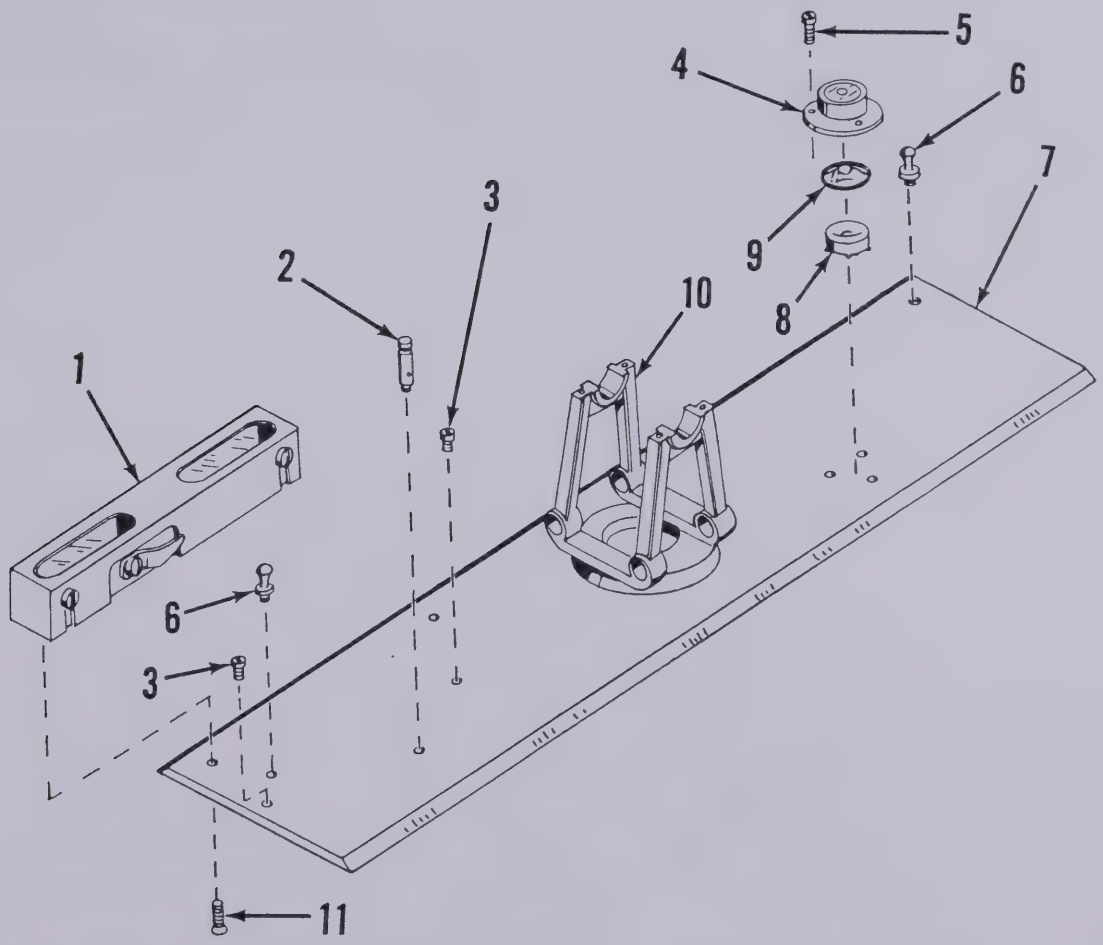
(1) Remove the striding level (par. 52*a*(1)).

(2) Remove the telescope (par. 45*b*).

(3) Remove the base plate knobs (6, fig. 24), following the procedures given in paragraph 48*b*(4).

(4) Remove the base plate level (4), following procedures given in paragraph 48*b*(3).

(5) Cover the jaws of a pair of pliers with cloth, flexible leather, or other suitable material, and remove the striding level stud (2, fig. 24) from the base plate (7).



EMC 6600-24

1 Trough compass
2 Striding level stud
3 Striding level stop screw (2 rqr)
4 Base plate level
5 Base plate level screw (3 rqr)
6 Base plate knob (2 rqr)
7 Base plate, alidade
8 Level vial
9 Plaster-of-paris
10 Standard, alidade
11 Screw, flat, cs hd, $\frac{3}{16}$ NF (2 rqr)

Figure 24. Base plate components partially exploded view.

(6) Remove the two striding level stop screws (3).

(7) Remove the trough compass (1), following procedures given in paragraph 48*b* (5).

b. Cleaning and Inspection. For cleaning and inspection of the base plate components, refer to paragraphs 48*c*, 45*c*, and 50*b*.

c. Reassembly and Installation.

(1) Install the trough compass (1, fig. 24), following procedures given in paragraph 48*d* (3).

(2) Place the alidade in an upright position and install the two striding level stop screws (3). Install the striding level stud (2).

(3) Reassemble and install the base plate level (4), following procedures given in paragraph 48*d* (1).

(4) Install the base plate knobs (6), following procedures given in paragraph 48*d* (2).

(5) Replace the telescope (par. 45*d*).

(6) Replace the striding level (par. 52*c* (7)).

CHAPTER 4
FIELD AND DEPOT MAINTENANCE

Section I. INTRODUCTION

54. General

Instructions in this chapter are published for the use of personnel responsible for third and higher echelons of maintenance of the alidades. They contain information on maintenance which is beyond the scope of the tools, equipment, or supplies normally available to using organizations.

55. Procedure

The following sections describe the complete disassembly, repair, and reassembly of each major unit or system comprising the alidades. Before proceeding with overhaul, check to see that replacement parts are available.

Section II. TOOLS AND EQUIPMENT

56. General

The tools and equipment as listed in this section are those that are required to perform field and depot maintenance on alidades. Common mechanic's handtools and special surveying instrument toolkits are not enumerated in this section.

57. Specially Designed Tools and Equipment

Tools and equipment in table II are for use of field and depot maintenance personnel performing major overhaul work on the alidades. The tools listed in table II are not available for issue, but must be fabricated by qualified field and depot personnel.

Section III. TELESCOPE ASSEMBLY, MODELS 5093A AND 5187A

58. Description

The telescope consists of a telescope body (7, fig. 1) fitted at the objective end with an objective lens (8), dust cap (1, fig. 2), and sunshade (2). Bearings are provided to support the striding

level (2, fig. 6) when used on the telescope. The rear of the telescope contains the eyepiece, reticule, and lens assemblies and controls. The telescope pivots in the vertical plane on the axle, mounted in the standard.

Table II. Specially Designed Tools and Equipment

Item	References		Use
	Fig.	Par.	
Compass needle pivot screwdriver.	25	64*b*	Remove compass pivot from compass base.
Pedestal	26	61*c*	Cross wire frame base when installing spider web.

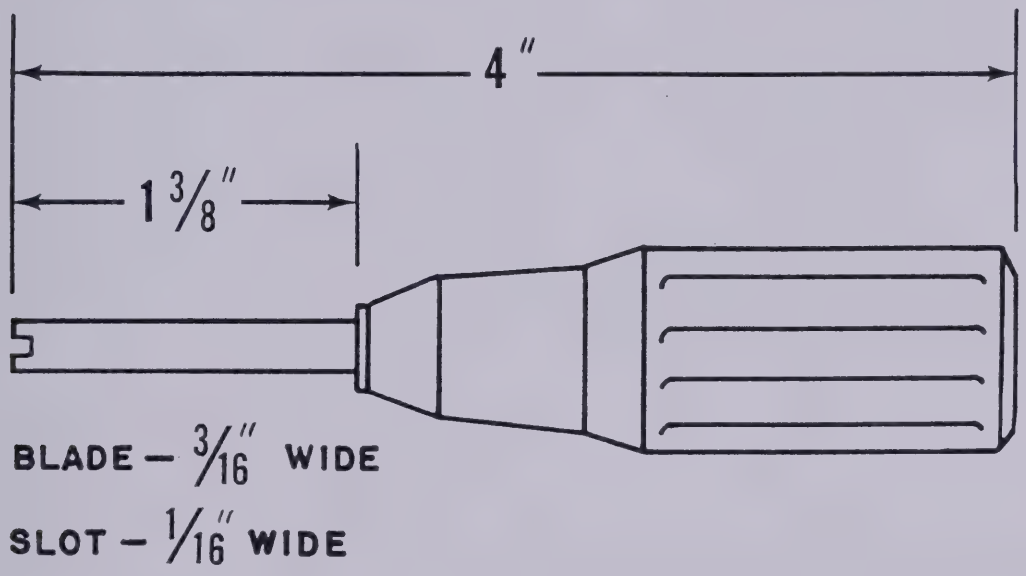


Figure 25. Compass needle pivot screwdriver.

59. Telescope Removal and Disassembly

a. Removal.

(1) Remove the striding level from the telescope (par. 43*a*).

(2) Remove the telescope from the alidade (par. 45*b*).

b. Disassembly.

(1) Remove the objective lens assembly (1, fig. 27) and the objective lens mount (2) from the front end of the telescope body (4). Slip the telescope lock ring (3) off the objective end of the telescope body (4).

Note. Do not remove the objective lens mount (2) from the telescope body (4) unless it is absolutely necessary. The mount is screwed so tightly to the telescope body that it is necessary to lay the telescope on a soft, flat surface and tap the mount with a soft-faced mallet to loosen the threads before attempting to unscrew the mount

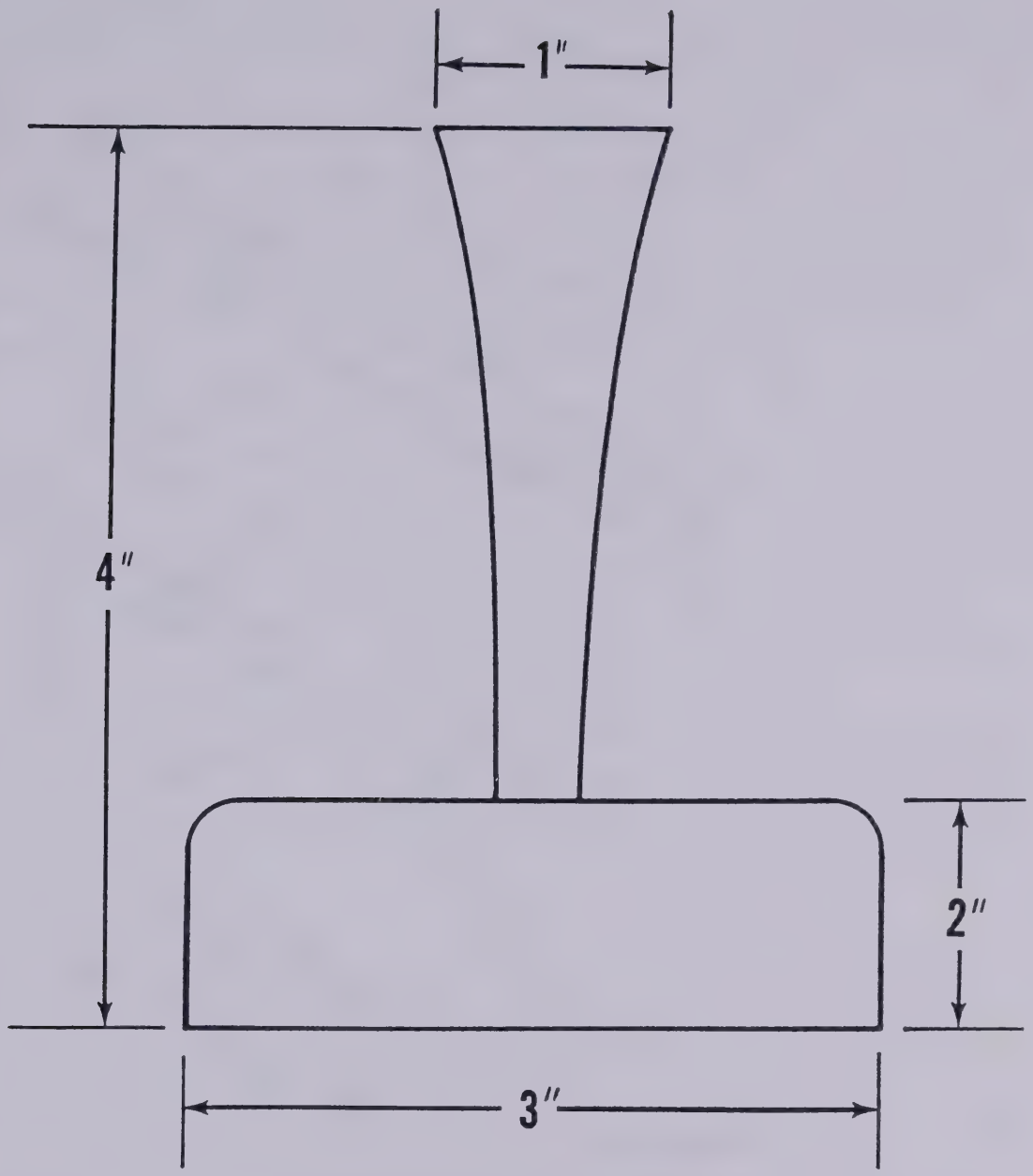
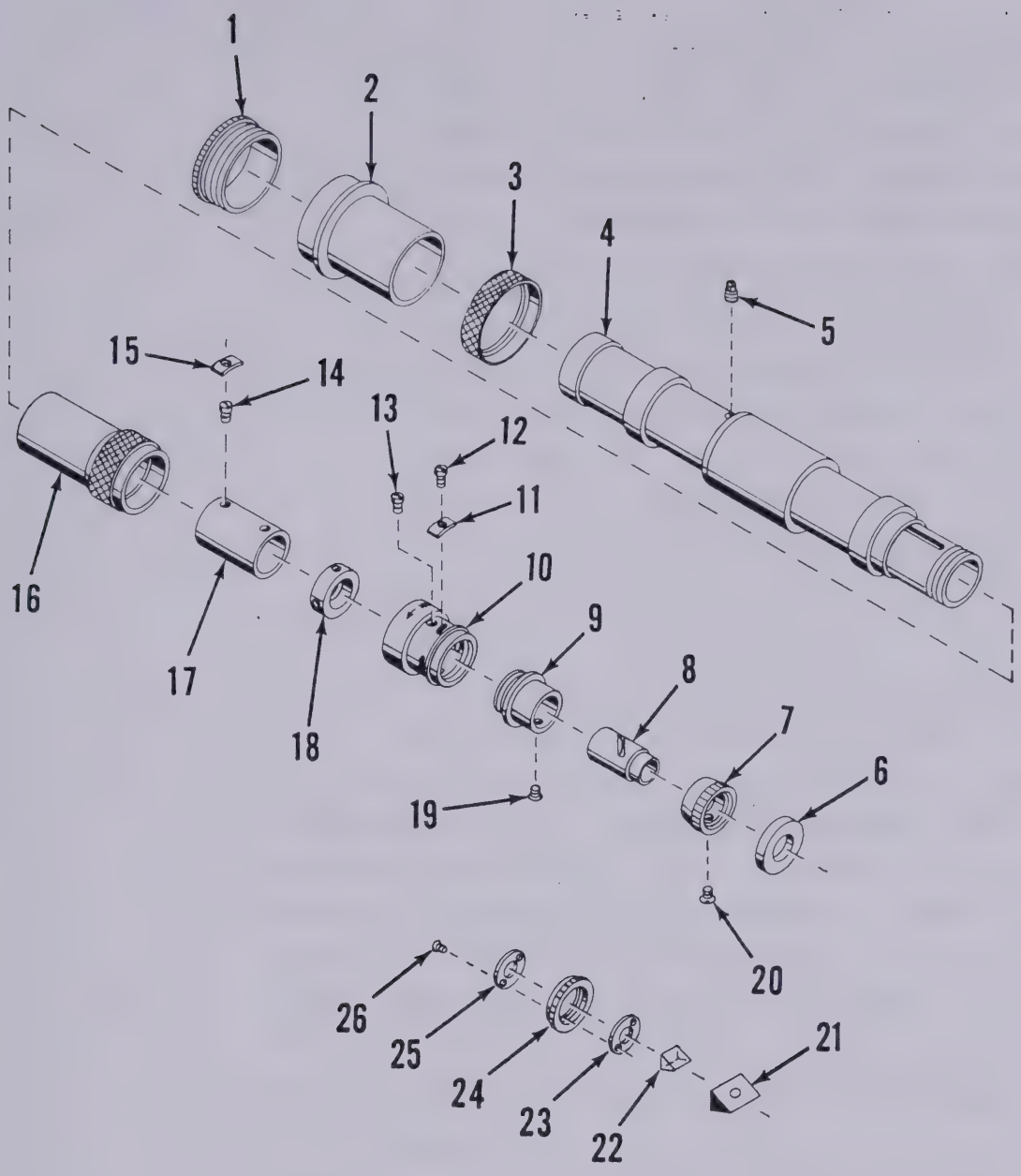


Figure 26. Pedestal.

from the telescope body. Check for, and remove, a small lock screw which may be holding the objective lens mount to the telescope body before loosening the threads with a mallet.

(2) Remove the eyepiece cap (6). Remove the eyepiece focusing ring lock screw (20) and unscrew the eyepiece focusing ring (7). Remove the eyepiece cam screw (19) and pull out the eyepiece cell mount (8). Remove the eyepiece sleeve (9).

(3) Turn the focusing lens cam (16) clockwise as far as it will go. Remove the eyepiece body retaining screw (13). Unscrew the eyepiece body (10).



EMC 6600-27

1	Objective lens assembly	14	Cam screw
2	Objective lens mount	15	Cam shoe
3	Telescope lock ring	16	Focusing lens cam
4	Telescope body	17	Draw tube
5	Telescope stop screw	18	Cross wire reticule
6	Eyepiece cap	19	Eyepiece cam screw
7	Eyepiece focusing ring	20	Eyepiece focusing ring lock screw
8	Eyepiece cell mount	21	Eyepiece prism mount
9	Eyepiece sleeve	22	Eyepiece prism
10	Eyepiece body	23	Eyepiece prism flange
11	Reticule adjusting screw shutter (4 rqr)	24	Prism eyepiece focusing ring
12	Eyepiece adjusting screw (4 rqr)	25	Prism mount spring
13	Eyepiece body retaining screw	26	Prism mount flange holder screw (2 rqr)

Figure 27. Telescope assembly, models 5093A and 5187A, exploded view.

(4) Place the eyepiece body (10) on a clean, flat surface with the eyepiece end up. Remove the four reticule adjusting screws (12) and reticule adjusting screw shutters (11). Lift the eyepiece body (10) from the reticule (18) and place the reticule in a dust-proof container.

Note. Use extreme care in removing the reticule from the eyepiece body so as not to damage the cross wires in the reticule.

(5) Press firmly against the focusing lens cam (16) and turn clockwise as far as possible. Then turn counterclockwise, while pulling out on the focusing lens cam (16) and remove the cam. Lift the cam shoe (15) from the cam screw (14). Remove the cam screw (14). Insert a piece of wood in the large opening of the draw tube (17) and pull it from the eyepiece of the telescope body (4).

(6) Remove the telescope stop screw (5) from the telescope body (4)

Note. Do not attempt to remove the telescope stop screw (5) from the telescope body (4) unless it is absolutely necessary.

c. Prism Disassembly. Remove the two prism mount flange holder screws (26). Remove the eyepiece prism mount (21) from eyepiece prism flange (23). Remove the eyepiece prism (22) from the eyepiece prism mount (21). Remove the prism mount spring (25) from the prism eyepiece focusing ring (24).

Note. Paper shims may be found in the eyepiece prism mount (21) with the eyepiece prism (22). They are used to secure the prism in the prism mount.

60. Telescope Cleaning, Inspection, and Repair

a. Cleaning.

Note. The cleaning, inspection, and repair of the reticule assembly is covered in paragraph 61.

(1) Clean all parts with approved cleaning solvent. Wipe lens assemblies clean with lens tissue moistened in cleaning solvent, taking care not to touch lens surfaces. Brush threaded parts with a toothbrush dipped in cleaning solvent. Dry all parts with a clean, soft cloth.

(2) Clean lens surfaces with a camel's hair brush or lens tissue. If any fingerprints or smears remain, wipe the lens gently with a soft cotton cloth moistened with suitable lens cleaner.

Note. A good lens cleaner can be prepared from a 50/50 percent solution of methyl or grain alcohol and acetone. The alcohol should not contain denaturants which leave a film.

b. Inspection. Check all threaded surfaces for worn or damaged threads. Inspect the eyepiece cam screw (19) for burs and wear. Check the groove in the eyepiece cell mount (8) for wear and burs.

Inspect the objective lens mount (2) and telescope body (4) for dents, cracks, and breaks. Check the draw tube (17) for scoring, burs, and breaks. Inspect the lens assemblies for loose mountings, scratches, and fungus etching.

c. Repair. Remove burs with swiss pattern file. Straighten all minor dents. Replace worn or damaged parts, or report the condition to proper authority.

Caution: Do not attempt to disassemble or repair lens assemblies. If lenses are damaged or defective, report the condition to proper authority. Lens assembly repair is a function of depot instrument shop.

61. Cross Wire Reticule Cleaning, Inspection, and Repair

a. Cleaning.

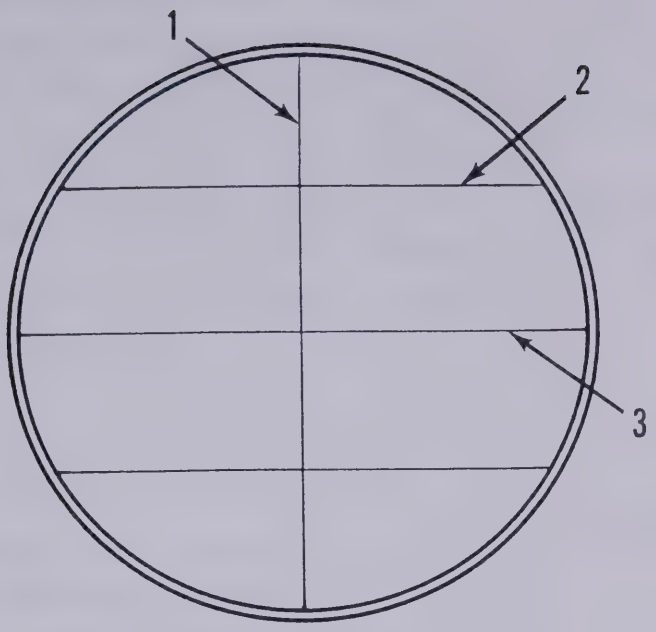
(1) If the cross wires in the cross wire reticule assembly are dirty, they may be cleaned. Great care must be used in the cleaning process so as not to break the cross wires or push them out of line.

(2) Alidade cross wires may be of glass, platinum, or spider web. By looking through the eyepiece with the telescope pointed toward a light background before disassembling begins, the composition of the cross wires may be determined by the pattern the wires make.

(3) If the cross wires are platinum or spider web, the pattern will appear like that in (A, fig. 28). If the cross wires are glass, the pattern will appear like that in (B).

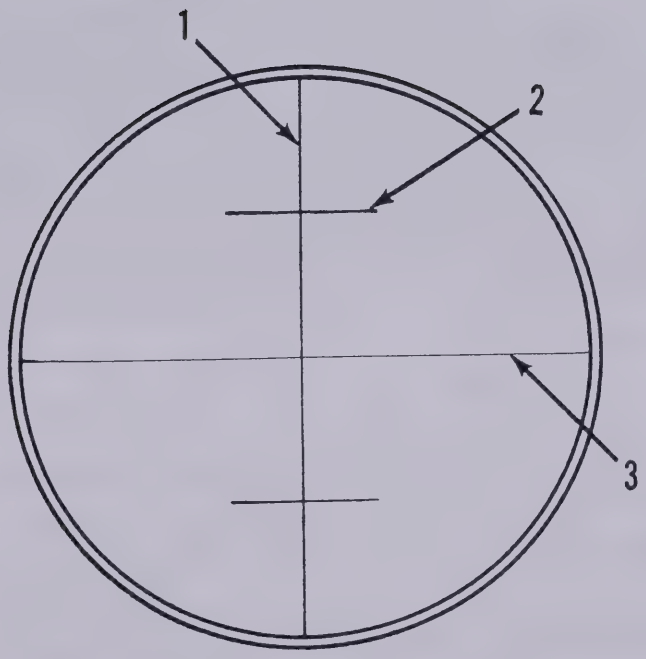
(4) Lay the cross wire reticule on a clean, flat surface. Make a brush by fastening a single straight fine hair to the end of a match or toothpick, with the hair extending about one-half inch. If the cross wires are of platinum or spider web, tickle the wires with the brush very carefully to remove dust adhering to the wires. The wires will break under the slightest pressure, so great care must be used. If the dust is gummed to the wire, it cannot be removed and the wire must be replaced.

(5) If the cross wires are glass, dust usually can be sucked off the wires with a rubber ear syringe, holding the nozzle near the surface of the glass and releasing the bulb. If this does not remove the particles and they appear to be dust that will not smear, a single stroke of a camel's hair brush will remove the particles. The brush should be washed in ether before attempting to clean the wires.



A

PLATINUM OR SPIDER WEB



B

GLASS

EMC 6600-28

A

1 Vertical cross wire
2 Stadia
3 Horizontal cross wire

B

1 Vertical cross wire
2 Stadia
3 Horizontal cross wire

Figure 28. Difference in cross wire patterns.

(6) If a smear results from the cleaning process, it may be removed with chloroform. Make a small swab of surgical cotton and a toothpick. Moisten the cotton in chloroform or lens cleaner. Use extremely light pressure, otherwise sections of the line may be rubbed off.

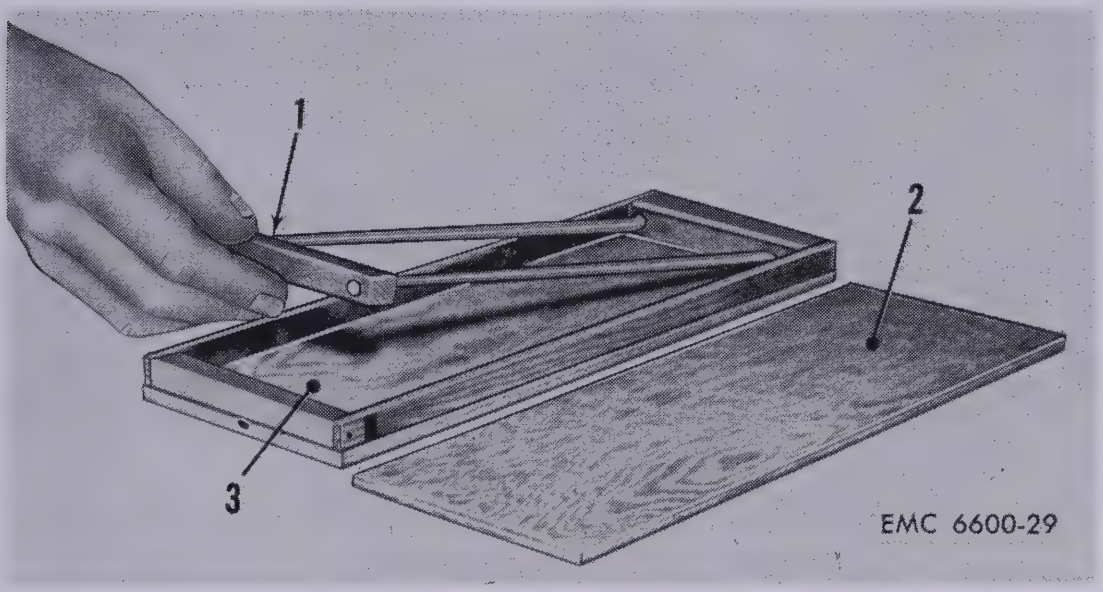
b. Inspection. Inspect the cross wire reticule for scratches, and broken, missing, or out-of-line cross wires. Check to make sure the cross wires are securely fastened to the cross wire reticule. Replace defective or broken cross wires.

c. Repair.

Note. If the cross wire reticule needs resurfacing and scribing, report the condition to proper authority. Scribing the reticule must be done at depot instrument shop.

(1) Carefully remove the cover (2, fig. 29) from the shipping box (3) containing the spider web reel (1).

Caution: Do not brush the fingers, or any object, through the reel (1) as this will destroy the spider web.

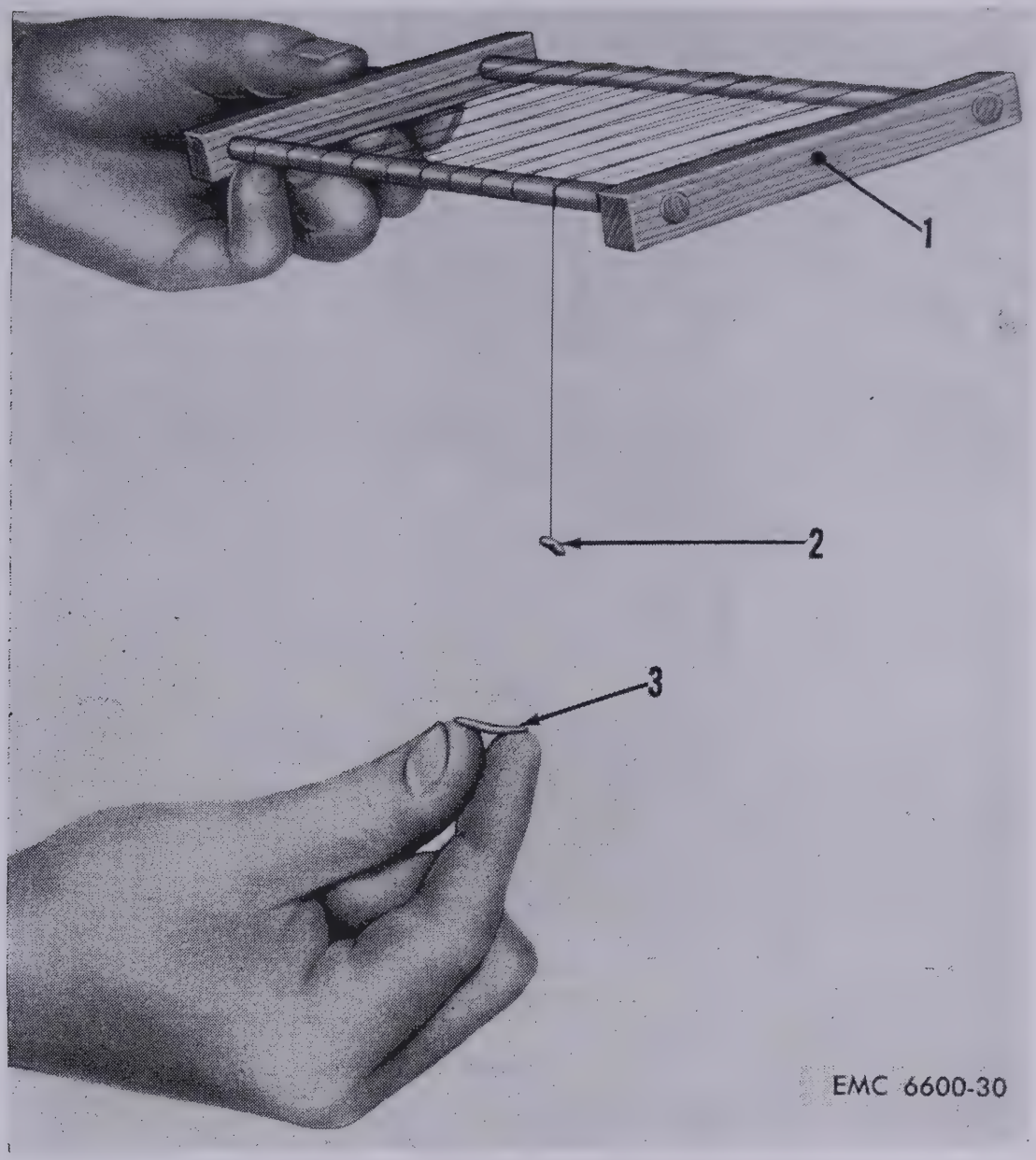


1 Spider web reel 2 Cover 3 Shipping box

Figure 29. Removing spider web reel from shipping box.

(2) Lift the spider web reel (1) from the shipping box (3) with the fingers, by grasping the reel at the end of the shipping box where the reel is held away from the box by the wood blocking.

(3) Hold the spider web reel (1, fig. 30) in one hand and, holding the reel to the light to locate a strand of web, pinch one end of the strand from the reel, using a tiny piece of rolled-out modeling clay (3) held between the thumb and finger. Let the end of the web (2), weighted by the modeling clay, hang loose.



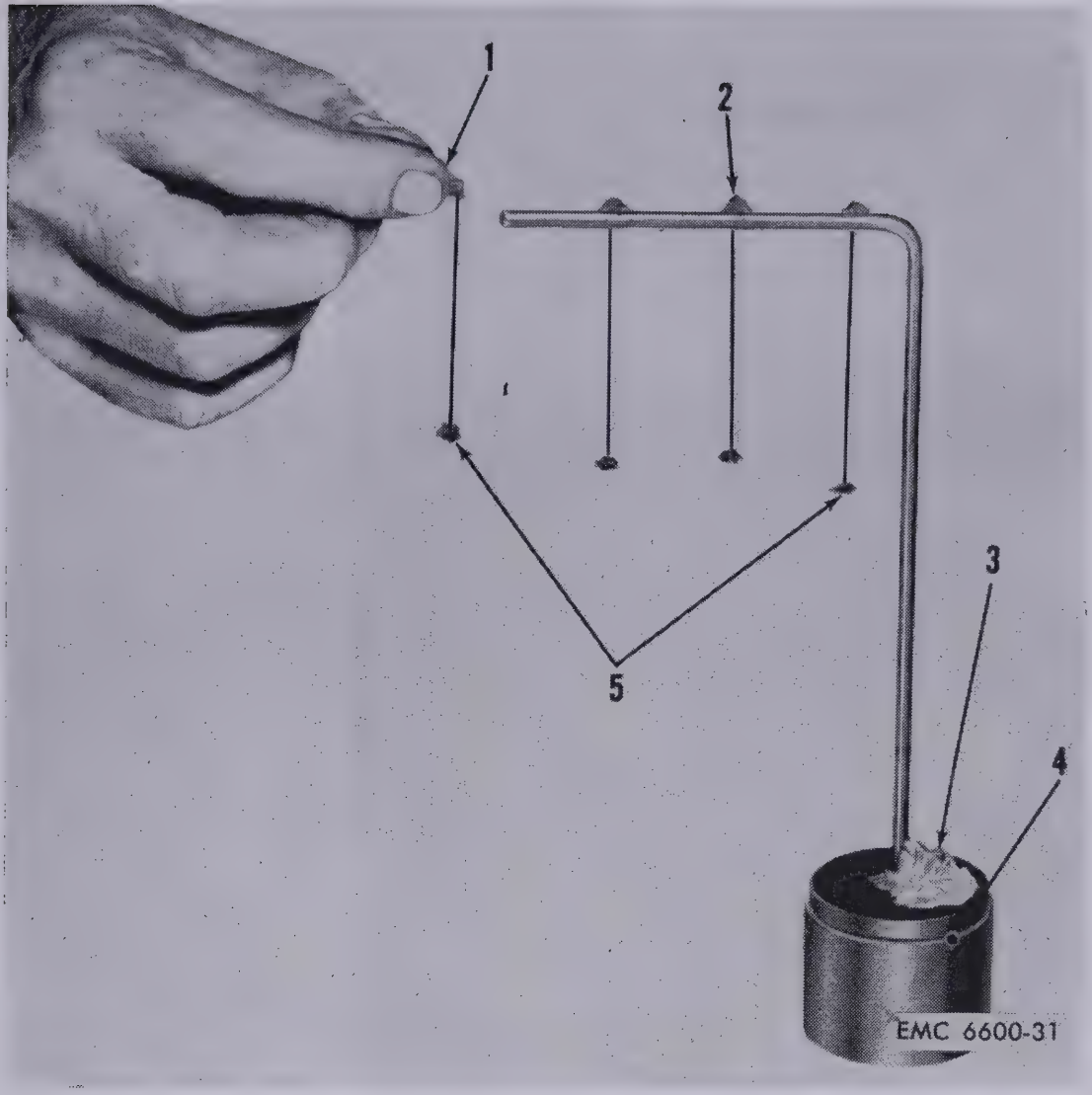
1 Spider web reel 2 Loose end of web strand 3 Modeling clay

Figure 30. Removing spider web from reel.

Caution: Do not use too large a piece of modeling clay as the web is fragile and will break under the weight of a large piece of clay.

(4) Pinch the other end of the web from the reel and place the strand (2, fig. 31) on the web-holding stand (4). Repeat the procedure until there are four strands (2) suspended from the stand. The stand may be made from any suitable base in which an L-shaped wire is installed. The base of the stand (4) is a convenient place to store modeling clay (3) until needed.

(5) Dip a small camel's hair brush in acetone and carefully brush down both sides of each strand suspended on the



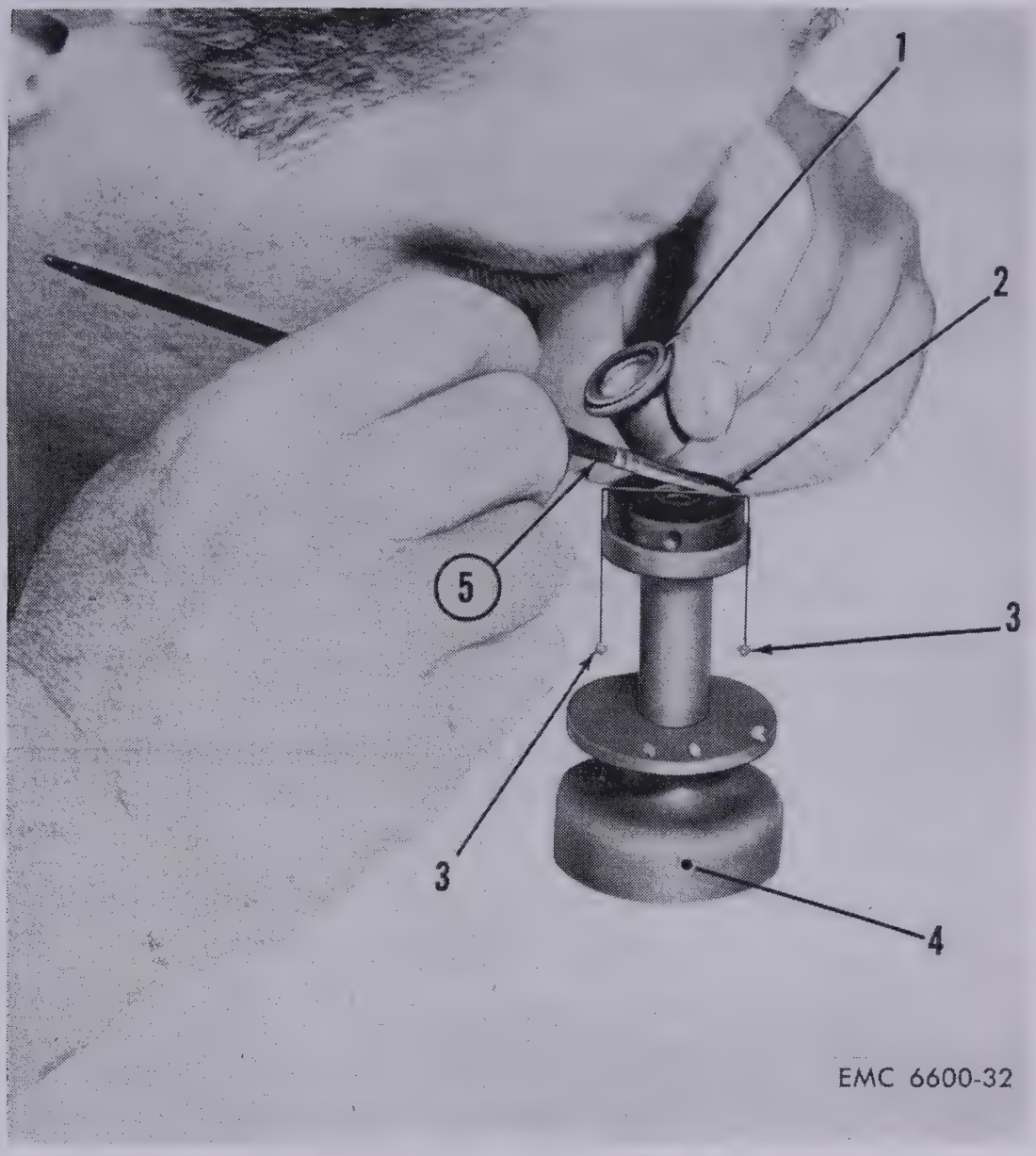
1 Hand holding web strand
2 Web strand on stand
3 Modeling clay
4 Web holding stand
5 Clay weight on strand

Figure 31. Placing spider web on holding stand.

web holding stand (4) to clean it. Wash the face of the cross wire frame (2, fig. 32) with a clean, soft rag dipped in acetone. Place the frame on the pedestal (4). The pedestal should approximate the dimensions shown in figure 26.

(6) Lay a web strand across the cross wire frame (2) in one of the stadia scribings (2, fig. 28), with the clayed ends (3, fig. 32) hanging down each side, putting tension on the web. Use a magnifying glass (1) and a brush (5) dipped in acetone to brush the web into position in the center of the scribing on the cross wire frame.

(7) When the web is centered, tack it to the cross wire frame (2, fig. 33) with three dots of adhesive on each side of the



1 Magnifying glass
2 Cross wire frame
3 Weighted end of spider web
4 Pedestal
5 Brush

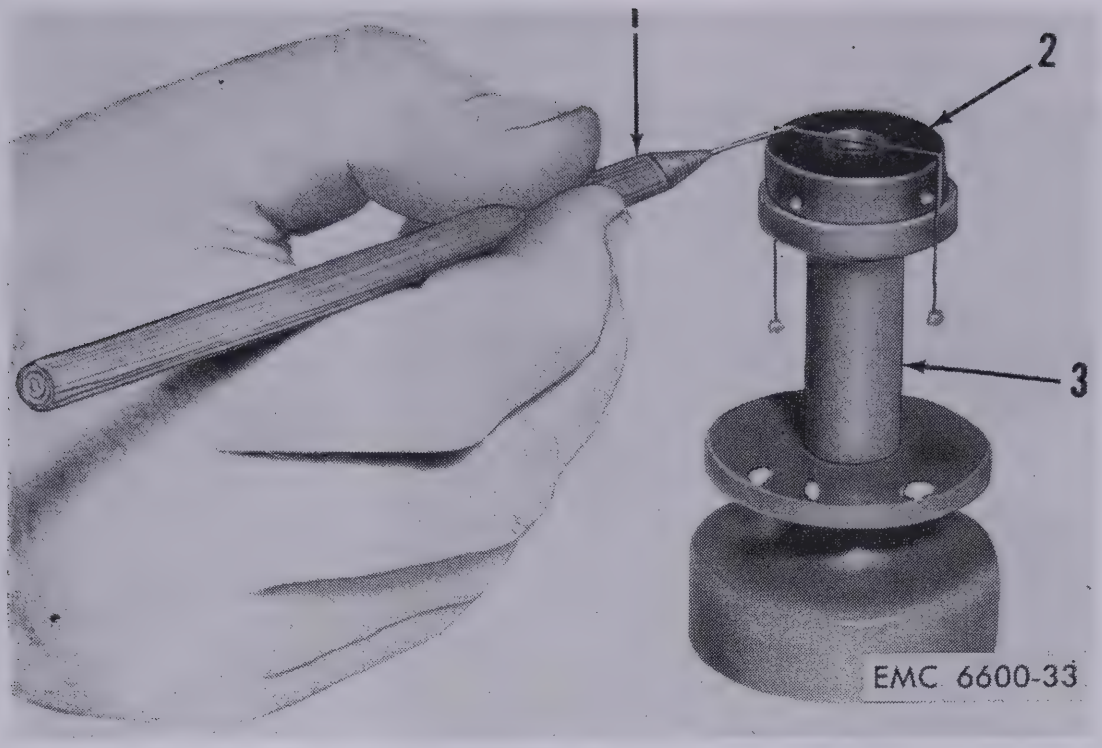
Figure 32. Placing spider web in cross wire frame.

center opening. Use a wire-tipped stick (1) or needle to apply the adhesive. Let dry.

Note. A suitable adhesive can be made from 50 percent acetone (4) and 50 percent household cement.

(8) After the adhesive is dry, install the horizontal cross wire (3, fig. 28), the second stadia (2), and the vertical cross wire (1) in that order.

(9) When the four web strands are correctly installed, steady the cross wire reticle (1, fig. 34) on the pedestal (2) with the thumbs and forefingers. Press the tips of the thumbs on the edge of the cross wire reticule (1), over the web strands and remove the excess web by wiping the thumb tips down



1 Wire-tipped stick 2 Cross wire frame 3 Pedestal

Figure 33. Securing spider web in cross wire frame.

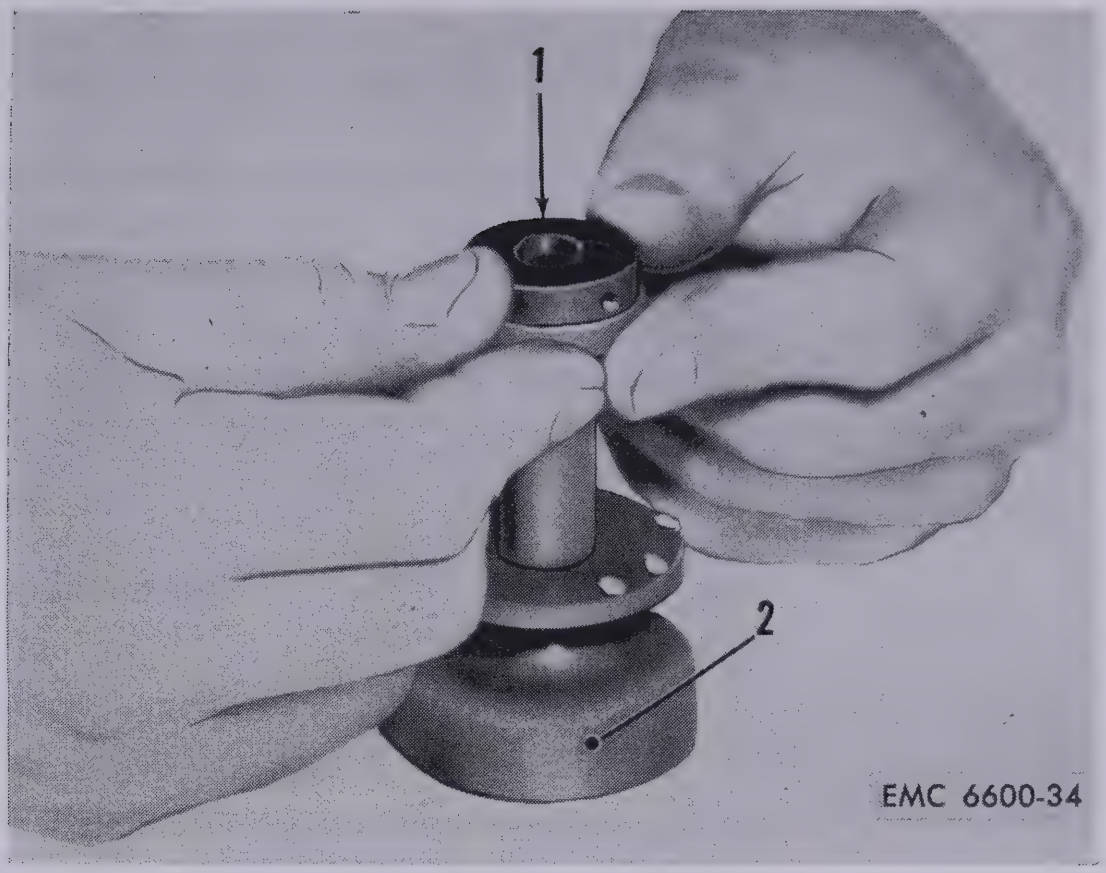
over the edge of the cross wire reticule. Repeat this procedure until all excess web has been removed from the four web strands.

62. Telescope Reassembly and Installation

a. Reassembly (fig. 27).

(1) Install the telescope stop screw (5), if removed, in the telescope body (4). Place a drop of oil at each end of the draw tube (17) and work it over the surface of the tube. Install the draw tube (17) in the end of the telescope body. Install the cam screw (14) in the draw tube (17) and place the cam shoe (15) over the cam screw. Grease lightly around the cam shoe (15) and the spiral guides of the focusing lens cam (16). Aline the opening in the spiral guides in the focusing lens cam (16). Aline the opening in the spiral guides in the focusing lens cam (16) with the cam shoe (15) and screw the draw tube (17) over the cam shoe as far as it will go. Turn several times to see that it moves freely. If it sticks, remove and check for burs.

(2) Install the cross wire reticule (18) in the objective end of the eyepiece body (10) with one end of the vertical cross wire pointing toward the INFINITY marking on the eyepiece body, and aline the holes. Place a reticule adjusting



1 Cross wire reticule 2 Pedestal

Figure 34. Removing excess spider web from cross wire reticule.

screw shutter (11) over a recticule adjusting screw (12) hole and install the screw through the eyepiece body (10) into the cross wire reticule (18). Repeat with the other three screws and shutters. Tighten the four screws until they are barely firm.

(3) Lightly grease the barrel of the eyepiece cell mount (8). Insert the eyepiece cell mount (8) in the eyepiece sleeve (9). Aline the hole in the eyepiece sleeve (9) with the groove in the eyepiece cell mount (8) and install the eyepiece cam screw (19). Screw the eyepiece sleeve (9) assembly in the eyepiece body (10).

(4) Screw the eyepiece body (10) assembly onto the telescope body (4) until the hole in the sleeve alines with the hole in the threaded part of the telescope body. Install the eyepiece body retaining screw (13).

(5) Slide the axle lock ring (3) over the objective end of the telescope body (4). Install the objective lens mount (2), if it has been removed from the telescope body (4). Screw the objective lens assembly (1) onto the objective lens mount (2).

(6) Screw the eyepiece focusing ring (7) onto the eyepiece cell mount (8). Aline the holes and install the eyepiece focusing ring lock screw (20). Install the eyepiece cap (6).

b. Installation.

(1) Install the telescope on the alidade (par. 45*d*).

(2) Install the striding level (par. 43*c*).

c. Prism reassembly.

(1) Install the prism mount spring (25) in the prism eyepiece focusing ring (24). Replace the eyepiece prism (22) and shims (if present) in the eyepiece prism mount (21).

(2) Position the eyepiece prism flange (23) on the prism eyepiece focusing ring (24). Place the eyepiece prism mount (21) assembly on the eyepiece prism flange (23). Aline the holes and install the two prism mount flange holder screws (25).

Section IV. TROUGH COMPASS

63. Description

The trough compass is located on the base plate at the operator's end, and consists of a trough compass inclosed in a box. The compass needle (4, fig. 35) is balanced on a jeweled bearing resting on the point of the compass pivot (8). When not in use, the compass needle (4) can be lifted against the compass cover glass (3) so it will not move. The compass base (7) is scribed with a fine center line at each end which indicates the alinement of the fiducial edge of the base plate, and the line of sight of the telescope.

64. Trough Compass Removal and Disassembly

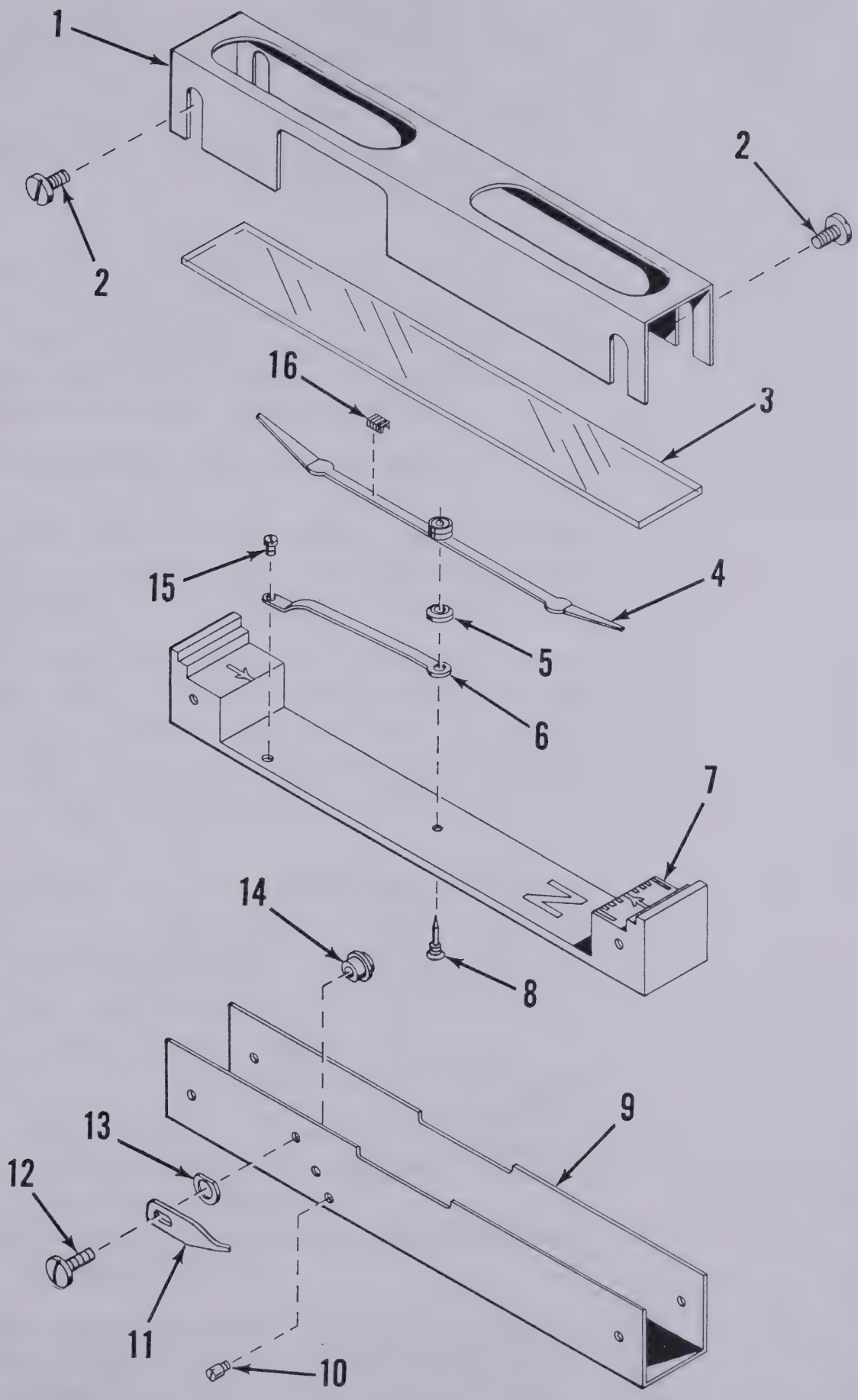
a. Removal. Remove the trough compass from the base plate (par. 48*b*).

b. Disassembly (fig. 35).

(1) Remove the four screws (2) and lift off the compass cover (1) and compass cover glass (3). Rub a little oil on the fingers to prevent tarnishing or rusting the needle, and carefully lift the compass needle (4) from the compass pivot (8).

(2) Remove the compass lever screw (12) and lift off the compass lever (11) and compass lever tension spring (13). Remove the compass needle cone (5), if present.

(3) Remove the needle lifter screw (15) and take out the compass needle lifter (6). Push the lever cam (14) into the compass trough (9) from the outside and remove the lever cam.



EMC 6600-35

Figure 35. Trough compass, exploded view.

1 Compass cover
2 Compass cover retaining screw (4 rqr)
3 Compass cover glass
4 Compass needle
5 Compass needle cone
6 Compass needle lifter
7 Compass base
8 Compass pivot
9 Compass trough
10 Lever stop screw (2 rqr)
11 Compass lever
12 Compass lever screw
13 Compass lever tension spring
14 Lever cam
15 Needle lifter screw
16 Wire balance

Figure 35—Continued.

(4) Remove the two lever stop screws (10) and lift the compass base (7) from the compass trough (9). Take the split screwdriver (fig. 25) and remove the compass pivot (8, fig. 35) from the bottom of the compass base (7).

65. Trough Compass Cleaning, Inspection, and Repair

a. Cleaning.

(1) Clean all metal parts, with the exception of the compass needle (4) and compass pivot, with approved cleaning solvent. Carefully wipe the compass needle with a soft, clean cloth.

(2) Clean the compass cover glass (3) by blowing on it and wiping clean with a soft cloth. Brush all threaded parts with a toothbrush dipped in cleaning solvent. Wipe dry.

(3) Clean the painted surface of the compass base with approved cleaning solvent and wipe dry. Touch up scratches or bare spots with white enamel.

b. Inspection.

(1) Inspect the compass cover (1), compass base (7), and compass trough (9) for dents, cracks, and breaks. Check the compass lever tension spring (13) and compass needle lifter for bends and fatigue. Inspect the compass cover glass (3) for cracks and chipped edges. Check all threaded surfaces for worn or damaged threads.

(2) Check the lever cam (14) and compass lever (11) for burs and wear. Inspect the compass needle (4) for bends and damaged jeweled bearing. Check the wire balance (16) for secure mounting on the compass needle (4). Check the compass pivot (8) point for damage.

(3) Replace defective parts that cannot be repaired or report the condition to proper authority.

c. Repair.

(1) Bend weak compass needle lifter (6) and compass lever tension spring (13) to give better spring effect. Remove burs from compass lever (11) and lever cam (14) with a fine file.

(2) Straighten minor bends and dents in the compass cover (1), compass base (7), and compass trough (9).

(3) Place the compass pivot in a pin vise. Put a little oil on an Arkansas stone and revolve the pivot point against the oiled side of the stone to sharpen it. Replace pivot if bent.

(4) If the compass needle has lost its magnetism, rub the north tip of the needle on the negative pole of a strong magnet. Rub the south tip of the needle on the positive pole of the magnet. Repeat the procedure until the needle is magnetized.

Note. Stroke each end of the needle an equal number of times on the magnet.

(5) If the wire balance (16) is too loose on the compass needle (4), tighten, or remove and replace. Take a length of 80-gage copper wire and wind several turns snugly around the south end of the needle at the center, making sure that the turns are close together.

66. Trough Compass Reassembly and Installation

a. Reassembly.

(1) Install the compass pivot (8) in the bottom of the compass base (7), using the split screwdriver (fig. 25). Make sure that the pivot is installed far enough so that it does not project from the bottom of the compass base. Position the compass base (7, fig. 35) in the compass trough (9).

(2) Install the two lever stop screws (10). Push the lever cam (14) into the compass trough (9) from the inside and position it so the flat side of the cam is in a horizontal position.

(3) Slide the end of the compass needle lifter (6) over the compass pivot (8), aline the hole in the other end with the hole in the compass base (7) and install the needle lifter screw (15). Install the compass needle cone (5) on the compass pivot.

(4) Position the compass lever tension spring (13) on the end of the lever cam (14) outside the compass trough (9). Position the compass lever (11) on the end of the lever cam (14) in a vertical position and install the compass lever screw (12).

(5) Carefully place the compass needle (4) on the compass pivot (8). Be sure to place the end of the needle, with the wire balance on it, to the south end of the compass box. Position the cover glass (3) and compass cover (1) on the compass trough (9) and install the four screws (2). Move the compass lever (11) to the horizontal position.

b. Installation. Install the trough compass on the base plate of the alidade (par. 48*d*).

67. Compass Care and Handling

a. Needle Balancing.

(1) The compass needle should be tested for balance when the alidade is set up, and when it is moved from one locality to another. The alidade should be level when the compass needle is tested for balance.

(2) Remove the compass cover (par. 64*b*(1)), and raise the compass lever. If the North end of the compass needle is too high, carefully lift the needle from the pivot, and cut off a piece of the wire balance. Replace the needle on the pivot and check for balance. Continue cutting off small pieces of wire balance until the needle is in balance.

(3) If the North end is too low, rewind the wire balance with a longer length of wire, and make the above test and adjustment for balance.

(4) Replace the compass cover (par. 66*a*(5)).

b. Handling Precautions.

(1) Lift the needle when not in use by moving the compass lever (11) to the horizontal position, forcing the needle against the compass cover glass (3, fig. 35), and lifting it from the pivot.

(2) When releasing the needle, let it come down on the pivot gently. An abrupt release lets the needle fall so as to damage the fine point of the pivot and reduce the sensitiveness of operation.

(3) The compass will function more efficiently if magnetic particles are removed from the operator's person or from near the compass.

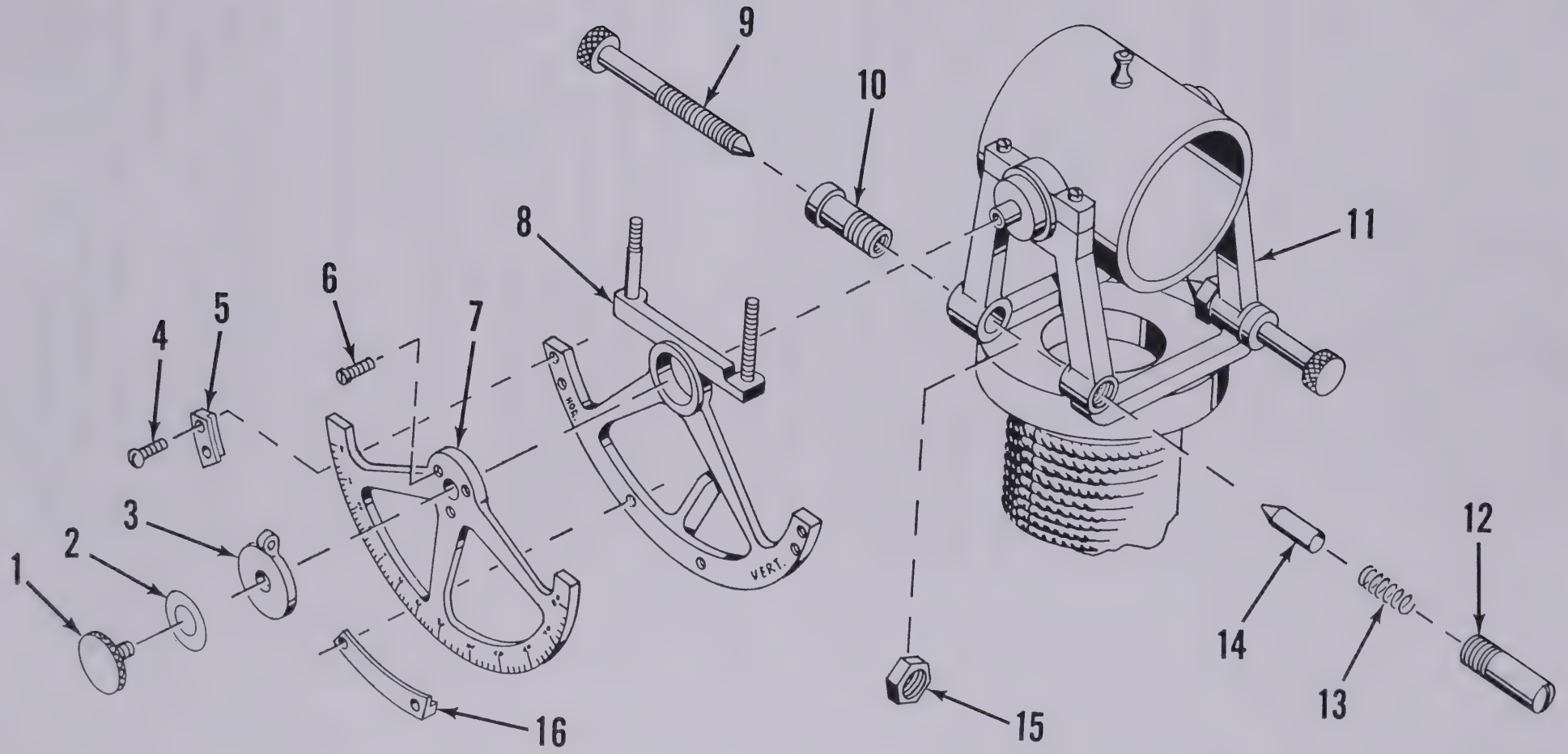
(4) If the cover glass becomes electrified, causing the needle to stick, touch the glass with a moistened finger.

(5) A sluggish needle results far more often from a dulled point on the pivot than from loss of magnetism.

Section V. VERNIER ASSEMBLY, MODELS 5093A AND 5187A

68. Description

The main components of the vernier assembly are the vertical arc (7) and the vernier arc (8, fig. 36). The vertical arc swings with the telescope and the vernier arc remains stationary. The magnifier (9, fig. 18) can be adjusted to read the fine graduations on the vernier (16, fig. 36) and indices (5).



EMC 6600-36

Figure 36. Vernier assembly, models 5093A, 5187A, and 5189A, exploded view.

AGO 4699B

1 Telescope axle rosette
2 Axle spring washer
3 Magnifier holder
4 Vernier and indice screw (6 rqr)
5 Indice (2 rqr)
6 Vertical arc screw (3 rqr)
7 Vertical arc
8 Vernier arc
9 Vernier arc tangent thumbscrew
10 Tangent thumbscrew bushing
11 Alidade mounting standard
12 Vernier arc plunger housing
13 Tangent screw plunger spring
14 Tangent screw plunger
15 Nut, hex, ⅜–32 x 1F–2
16 Vertical vernier

Figure 36—Continued

69. Vernier Assembly Removal and Disassembly

a. Removal.

(1) Remove the telescope (par. 45*b*).

(2) Remove the magnifier (par. 46*b*).

(3) Remove the control lever (par. 46*b* or 47*b*).

(4) Remove the vernier arc tangent thumbscrew (9, fig. 36) from the tangent thumbscrew bushing (10). Remove the vernier arc plunger housing (12) from the standard (11) and separate the tangent screw plunger (14) and tangent screw plunger spring (13) from the vernier arc plunger housing (12).

Note. Removal of the tangent thumbscrew assembly parts makes it less likely that components of the vernier assembly will be damaged when being disassembled.

b. Disassembly.

(1) Lay the alidade on its right side. Remove the axle rosette (1) the axle spring washer (2) and magnifier holder (3).

(2) Remove six screws (4) and lift off the two indices (5) and the vertical vernier (16). Remove three screws (6) and lift the vertical arc (7) from the telescope axle. Lift the vernier arc (8) from the telescope axle.

(3) Remove the hex nut (15) from the bushing (10) and pull the bushing from the standard (11).

70. Vernier Assembly Cleaning, Inspection, and Repair

a. Cleaning.

(1) Clean all parts, with the exception of the indices (5), vertical arc (7), and vernier (16) with approved cleaning solvent. Brush all threads with a toothbrush dipped in cleaning solvent. Dry all parts.

(2) Tarnish may be removed from the indices (5), vertical arc (7), and vernier (16) with an artgum eraser. Since the eraser contains sulphur, this type of cleaning is only

temporary. Apply watch oil to small slabs of charcoal which have been flattened by passing them over a piece of crocus cloth placed on a smooth, flat surface. The charcoal should be cut so the grain runs vertically. Clean the faces of the indices, vernier, and vertical arc with the charcoal. Do not clean in the direction of the graduations—move across them. Be careful about touching the edges of the graduations as the sharp divided edges may be easily rounded over.

b. Inspection. Inspect all threaded surfaces for worn or damaged threads. Check the vernier arc and vertical arc for worn, scratched, or damaged machined surfaces, and cracked or broken castings. Check all machined surfaces for burs. Check the vertical arc tangent thumbscrew assembly for burs, broken or fatigued plunger spring (13), and cracked or worn tangent screw plunger (14).

Note. If any component of the vertical arc tangent thumbscrew assembly is badly worn or damaged, replace the entire assembly.

c. Repair. Defective threads in the tangent thumbscrew assembly call for replacement of the complete assembly. Replace defective vernier arc (8) and vertical arc (7).

71. Vernier Assembly Reassembly and Installation

a. Reassembly.

(1) Install the bushing (10) and hex nut (15) in the standard (11).

(2) Lay the alidade on its right side. Oil the bearing in the vernier arc (8)and install the arc on the telescope axle. Place one drop of oil on the back of the vertical arc (7). Position the vertical arc over the vernier arc (8) and aline the holes in the vertical arc and the telescope axle. Install the three vertical arc screws (6).

(3) Install the two indices (5) and the vernier (16) with the six vernier and indice screws (4), tightened just snug. Shift the vernier (16) until the side play is equal before tightening the screws. Lock the telescope clamp screw (9, fig. 1). Set the 30° mark on the vertical arc (7, fig. 36) with the arrow on the vernier (16). With a jeweler's hammer, tap the horizontal indice until it lines up with the 100° reading on the vertical arc. Tighten the screws (4). Repeat the above procedure with the vertical indice, lining it up with the 50° reading on the vertical arc. Vernier and indices may have to be shimmed so they do not bind on the vertical arc.

(4) Install the magnifier holder (3) and axle spring washer (2),

and secure them to the telescope axle with the axle rosette (1).

(5) Install the vernier arc tangent thumbscrew (9) in the tangent thumbscrew bushing (10). Place the tangent screw plunger spring (13) in the tangent screw plunger (14) and position the assembly in the telescope plunger housing (12). Install the assembly in the standard (11).

b. Installation.

(1) Install the control level (par. 46*d* or 47*d*).

(2) Install the magnifier (par. 46*d*).

(3) Install the telescope (par. 45*d*).

Section VI. STANDARD, PEDESTAL, AND BASE PLATE, MODELS 5093A AND 5187A

72. Description

The standard (12, fig. 37) mounts most of the working parts of the alidade. Included in these are the telescope axle (4) and telescope; the telescope stop (20); the telescope clamp (6) and telescope clamp screw (5); the telescope tangent thumbscrew (18) assembly; the vernier assembly and the vernier arc tangent thumbscrew (fig. 36). The pedestal (14, fig. 37) holds the standard (12) to the base plate (15). The base plate (15) contains the trough compass, base plate level, and base plate knobs, in addition to the pedestal (14).

73. Standard, Pedestal, and Base Plate Removal and Disassembly

a. Removal.

(1) Remove the telescope (par. 45*b*).

(2) Remove the magnifier (par. 46*b*).

(3) Remove the control lever (par. 46*b* or 47*b*).

(4) Remove the vernier assembly (par. 69).

(5) Remove the telescope plunger housing (9, fig. 37) from the standard (12) and separate the tangent screw plunger (11) and tangent screw plunger spring (10) from the telescope plunger housing. Remove the hex nut (13) from the tangent thumbscrew bushing (17). Remove the tangent thumbscrew bushing (17) from the standard (12). Remove the telescope tangent thumbscrew (18) from the tangent thumbscrew bushing (17).

b. Disassembly.

(1) Remove the telescope clamp screw (5, fig. 37) from the telescope clamp (6). Remove the telescope clamp washer

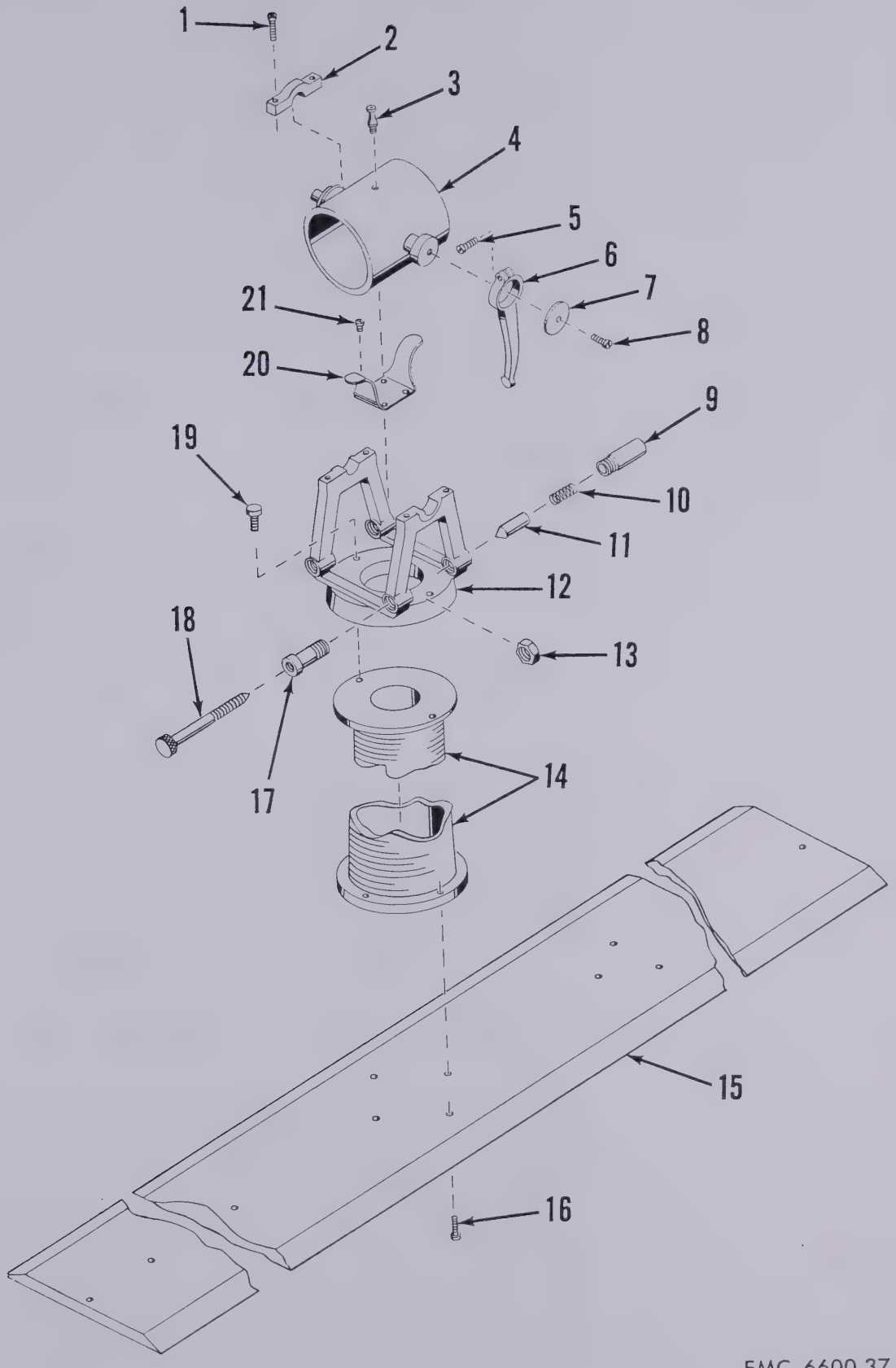


Figure 37. Standard, pedestal, and base plate, models 5093A and 5187A, exploded view.

1 Screw, br, fil hd, 7/32 NF (4 rqr)
2 Standard cap (2 rqr)
3 Striding level stud
4 Telescope axle
5 Telescope clamp screw
6 Telescope clamp
7 Telescope clamp washer
8 Telescope clamp washer screw
9 Telescope plunger housing
10 Tangent screw plunger spring
11 Tangent screw plunger
12 Standard
13 Nut, hex, 3/8–32 NF
14 Pedestal
15 Base plate
16 Screw, br, flat hd, 5/16 NF (4 rqr)
17 Tangent thumbscrew bushing
18 Tangent thumbscrew
19 Standard-to-pedestal screw (2 rqr)
20 Telescope stop
21 Telescope stop screw (4 rqr)

Figure 37—Continued.

screw (8) and lift off the telescope clamp washer (7) and the telescope clamp (6),

(2) Remove the four screws (1) and lift off the two standard caps (2).

Note. The standard caps (2) should be match-marked with their bearings on the standard (12). If the caps and bearings are not match-marked, they must be upon removal, as the caps and bearings are hand-fitted and will only work in one position.

(3) Lift the telescope axle (4) from the standard (12) and remove the striding level stud (3) from the axle. Remove the four telescope stop screws (21) and lift the telescope stop (20) from the standard (12).

(4) Match-mark the standard (12) and pedestal (14). Remove the two screws (19) and lift the standard (12) from the pedestal (14). Match-mark the pedestal (14) and base plate (15). Turn the base plate (15) upside down and remove the four screws (16) from the underside of the base plate, holding the pedestal (14) to the base plate.

74. Standard, Pedestal, and Base Plate Cleaning, Inspection, and Repair

a. Cleaning. Clean all metal parts with approved cleaning solvent. Brush threaded surfaces with toothbrush dipped in cleaning solvent. Wipe parts dry with soft, clean cloth. Clean painted surfaces with a soft cloth dipped in cleaning solvent and dry thoroughly.

b. Inspection. Inspect all threaded parts for worn or damaged threads. Check the telescope axle (4, fig. 37) for burs, scratches, and damaged bearing surfaces. Check the telescope clamp (6) for damaged machined surfaces, bends, and cracks. Inspect the telescope stop (20) for bends, cracks, and worn mounting holes. Check the standard (12) for cracks, breaks, burs, and damaged or worn bearing surfaces. Check the pedestal (14) for cracks, breaks, and damaged machined surfaces. Replace all damaged parts or report

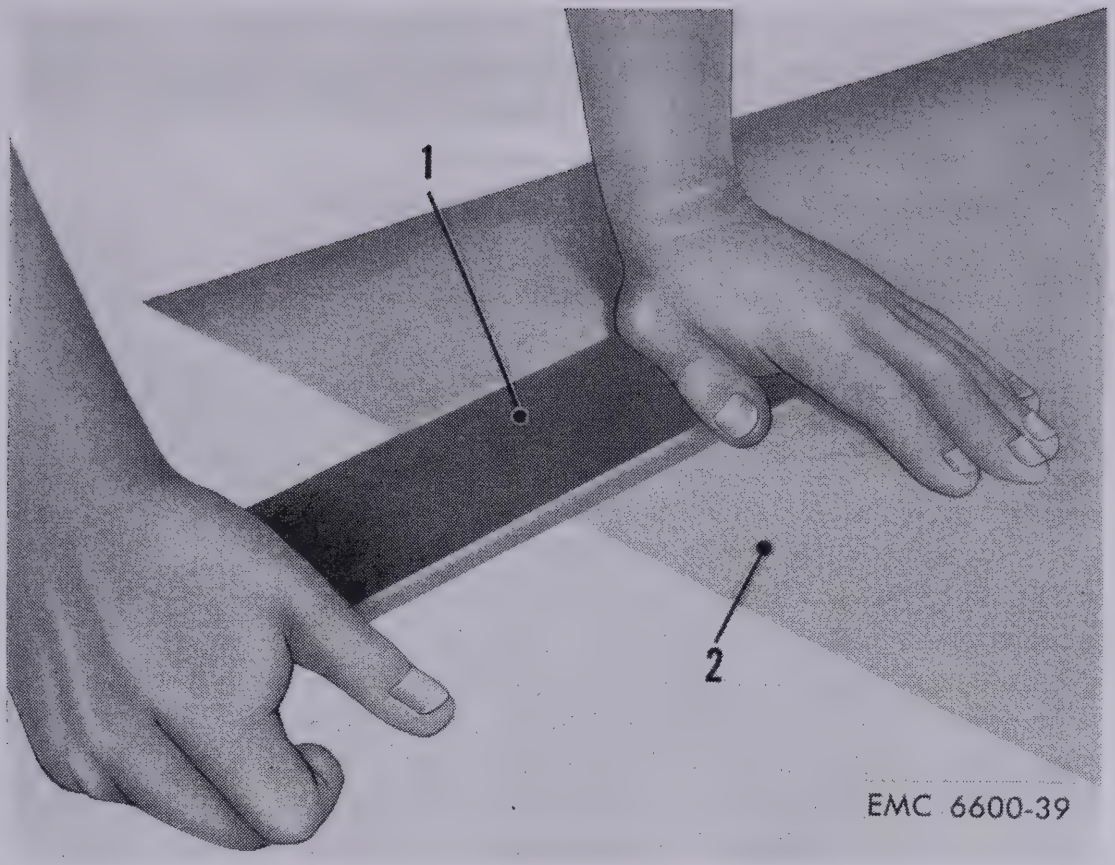
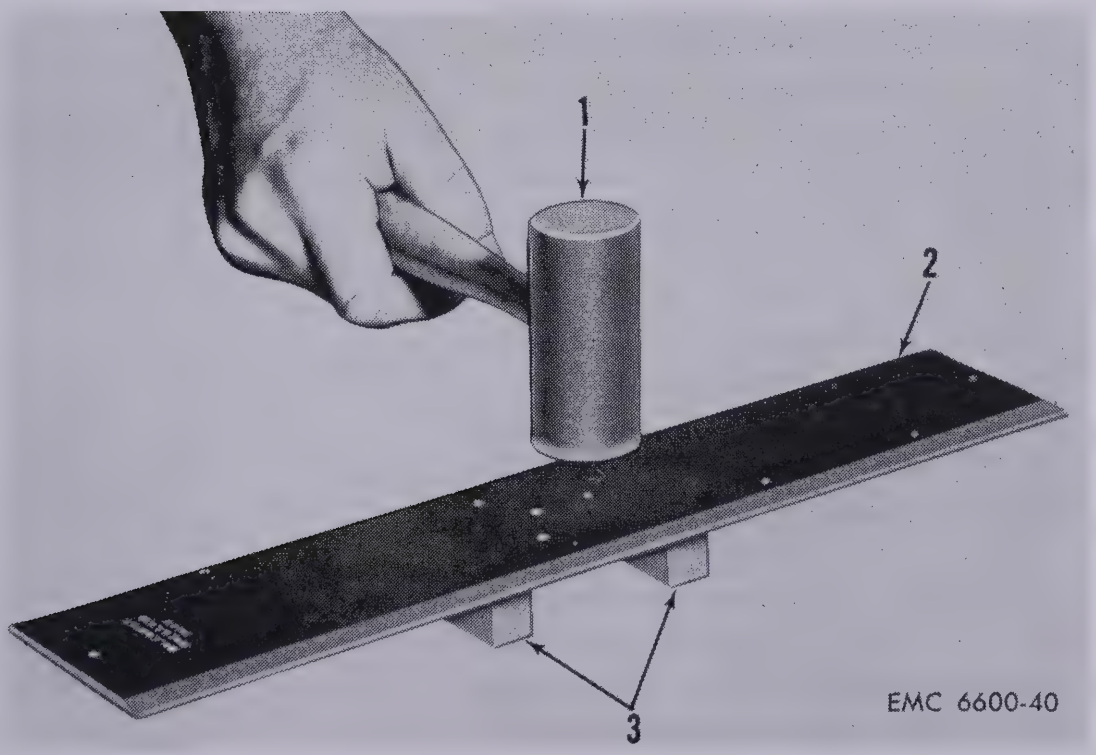


Figure 39. Straightening minor bends in base plate.



1 Wood blocks 2 High spot in base plate 3 Mallet

Figure 40. Removing high spots from base plate.

75. Standard, Pedestal, and Base Plate Reassembly and Installation

a. Reassembly.

(1) Aline the holes in the base plate (15, fig. 37) and pedestal (14), making sure that the match marks coincide. Install the four screws (16) in the bottom of the base plate (15). Aline the mounting holes in the pedestal (14) and the standard (12), making sure the match marks coincide. Install the two screws (19). Position the telescope stop (20) between the standard (12) and install the four telescope stop screws (21).

(2) Install the striding level stud (3) in the telescope axle (4). Place the telescope axle (4) on the bearing surfaces in the standard (12). Position the standard caps (2) over the telescope axle (4) bearings, making sure that the match marks on the caps (2) coincide with the match marks on the bearing surfaces in the standard (12). Install the four screws (1) and tighten. Make sure the bearing surfaces are touching the axle (4).

(3) Install the telescope in the telescope axle (par. 45*d*). Move the telescope to different positions from the horizontal. If the bearings are correctly adjusted, the telescope will stay in any position in which it is left. If the telescope will not stay in position, remove one standard cap (2). Take a No. 4 cut, flat file and pass the bottom surface of the standard cap over the file once. Install the standard cap (2) on the standard (12). Check the telescope again. Repeat filing if necessary. When telescope will remain in any given position and still will move freely, repeat the procedure with the standard cap (2) on the other side. Remove the telescope clamp. File the face of the telescope clamp (6) where the clamp tangent thumbscrew touches, so as to remove any dents observed at this point. If the point on the tangent screw plunger (11) is worn, replace.

(4) Install the telescope clamp (6) on the telescope axle (4). Position the telescope clamp washer (7) and the telescope clamp washer screw (8). Install the telescope clamp screw (5) in the telescope clamp (6). Install the telescope tangent thumbscrew (18) in the tangent thumbscrew bushing (17). Fit the assembly into the standard (12) and install the hex nut (13). Place the tangent screw plunger spring (10) in the tangent screw plunger (11) and install the assembly in the telescope plunger housing (9). Install the plunger housing (9) assembly in the standard (12).

b. Installation.

(1) Install the vernier assembly (par. 69*d*).

(2) Install the control level (par. 46*d* or 47*d*).

(3) Install the magnifier (par. 46*d*).

(4) Install the telescope (par. 45*d*).

Section VII. TELESCOPE ASSEMBLY, MODEL P5093A

76. Description

The telescope is the same as that found on the models 5093A and 5187A with the following exceptions. It has a cream-colored finish as opposed to a black finish on models 5093A and 5187A. The eyepiece lens assembly is different. This model is equipped with a glass reticule.

77. Telescope Removal and Disassembly

a. Removal. Remove the telescope from the alidade (par. 45*b*).

b. Disassembly.

(1) Remove the eyepiece cap (1, fig. 41) from the telescope (8). Remove the screw (7) and pull the eyepiece lens assembly from the telescope.

(2) Remove the setscrew (3) from the eyepiece focusing ring (2) and screw eyepiece cell (6) from focusing ring. Remove the setscrew (5) from the eyepiece definition ring (4) and remove the eyepiece definition ring from the focusing ring (2).

(3) For disassembly of the rest of the telescope, refer to paragraph 59*b*.

78. Telescope Cleaning, Inspection, and Repair

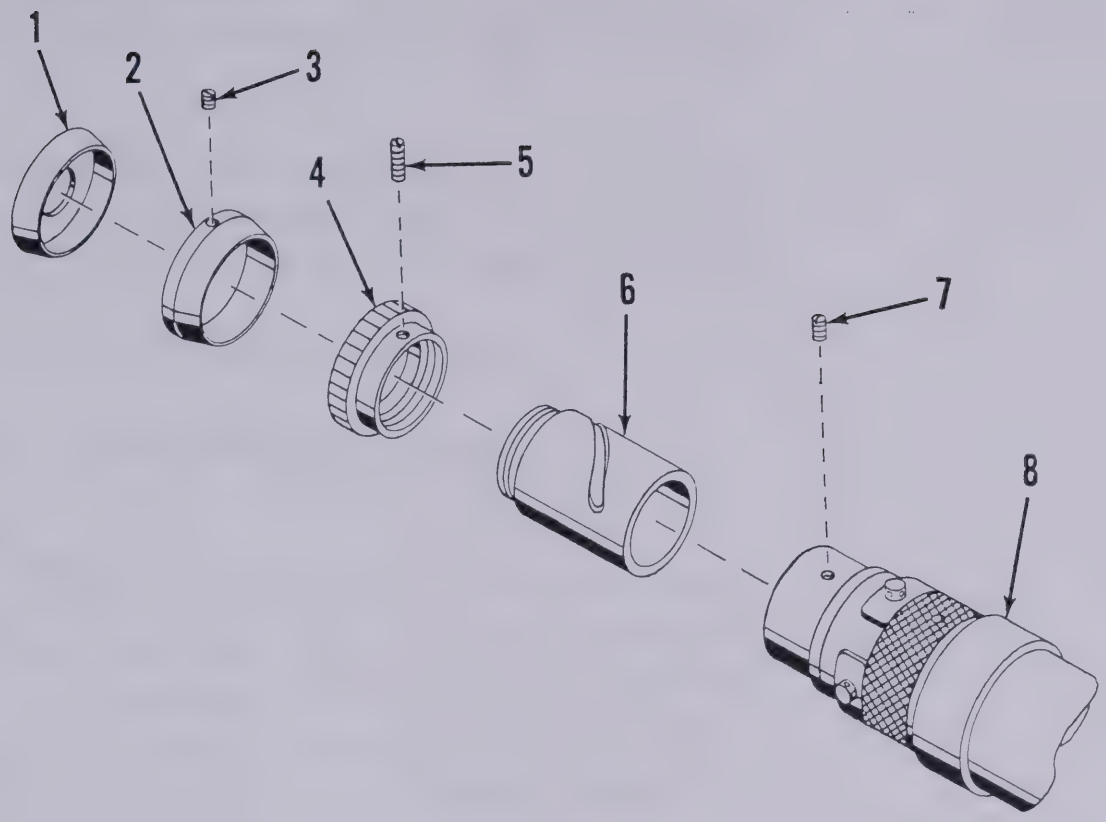
a. Cleaning.

(1) Brush all screws with a toothbrush moistened with approved cleaning solvent. Wipe the eyepiece cap (1, fig. 41), eyepiece ring (2), eyepiece focusing ring (4), and the barrel of the eyepiece cell (6) with a soft rag moistened with approved cleaning solvent.

(2) To clean the remaining parts of the telescope, refer to paragraphs 60*a* and 61*a*.

b. Inspection.

(1) Inspect all screws for worn or damaged threads. Check the eyepiece cap (1, fig. 41), eyepiece ring (2), and eyepiece focusing ring (4) for bends, cracks, and breaks. Check the



EMC 6600-41

1 Eyepiece cap
2 Eyepiece focusing ring
3 Screw, eyepiece focusing ring retaining
4 Eyepiece definition ring
5 Screw, eyepiece definition retaining
6 Eyepiece cell
7 Screw, spiral guide
8 Telepscope

Figure 41. Eyepiece and lens assembly, model P5093A, exploded view.

eyepiece cell (6) for burs, damaged threads, and dirty, cracked, or broken lenses.

(2) Inspect the remaining parts of the telescope (pars. 60*b* and 61*b*).

c. Repair.

(1) Replace screws with worn or damaged threads. Straighten minor bends or replace cracked or badly bent parts. Smooth minor burs in eyepiece cell (6, fig. 41) groove with a swiss pattern file.

(2) Repair the remaining parts of the telescope (pars. 60*c* and 61*c*).

79. Telescope Reassembly and Installation

a. Reassembly.

(1) Reassemble all parts of the telescope with the exception of the eyepiece and lens assembly (par. 62*a*).

(2) Install the eyepiece focusing ring (2, fig. 41) on the eyepiece cell (6). Aline the holes and install the screw (3).

Place the eyepiece definition ring (4) on the eyepiece focusing ring (2), aline the holes, and install the eyepiece cam screw (5).

b. Installation.

(1) Slide the eyepiece cell (6) assembly into the telescope (8) and aline the groove in the eyepiece with the mounting hole in the telescope. Install the screw (7). Install the eyepiece cap (1).

(2) Install the telescope in the alidade (par. 45*d*).

Section VIII. DAMP-INDUCTED COMPASS

80. Description

The damp-inducted compass operates the same as the trough compass (par. 63) and is interchangeable with the trough compass on the base plate of all Keuffel and Esser alidades. The needle in the damp-inducted compass is self-damped by induction, is very strongly magnetized, and has the advantage of coming to rest immediately. The strongly magnetized needle is much more violently affected by sudden movements of the magnetic material in its vicinity. If an automobile should pass, or the instrumentman be carrying a penknife, the needle will "kick" both horizontally and vertically far more than an ordinary needle which is not so sensitive.

81. Damp-Inducted Compass Removal, Disassembly, Cleaning, Inspection, and Repair

a. Removal. Remove the compass from the base plate (par. 48*b*).

b. Disassembly.

(1) Remove the four compass base and cover tube screws (15, fig. 42). Gently lift the compass cover tube (1) straight up from the compass base (10). Do not remove the trough compass glass (6) unless it is broken. It is almost impossible to remove an undamaged glass without damaging it.

(2) Remove the lever stop setscrew (14) from the compass cover tube (1). Remove the compass lever screw (5) and lift off the compass lever (4) and compass lever tension spring (3). Remove the lever cam (7). Remove the screw (2) and lift out the compass needle bumper block (13).

(3) Remove the compass needle (8) from the base pivot (10). Remove the screw (11) and lift out the compass needle lifter (9).

Note. Do not attempt to remove the pivot from the compass base (10) as it is pressed into the base. If the pivot is damaged, return the compass to depot instrument shop for repair.

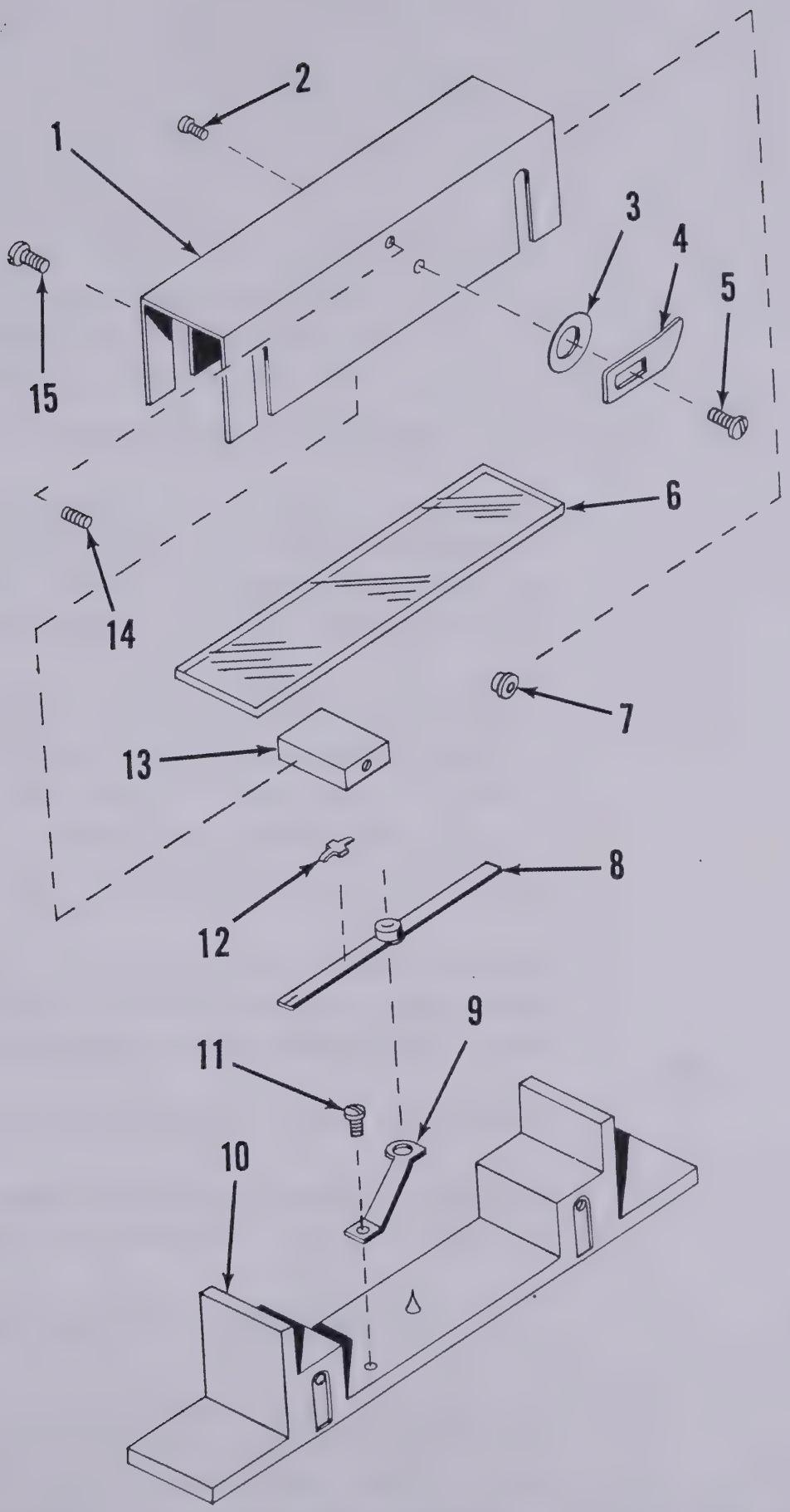


Figure 42. Damp-inducted compass, exploded view.

1 Compass cover tube
2 Screw, bumper block retaining
3 Compass lever tension spring
4 Compass lever
5 Compass lever screw
6 Trough compass glass
7 Lever cam
8 Compass needle
9 Compass needle lifter
10 Compass base w/pivot
11 Screw, flat hd, $\frac{4}{56}$ NF
12 Spring balance
13 Compass needle bumper block
14 Lever stop setscrew
15 Screw, compass cover tube (4 rqr)

Figure 42—Continued.

c. Cleaning. Clean all parts of the compass (par. 65*a*).

d. Inspection. Inspect all parts of the compass (par. 65*b*).

e. Repair. Repair the parts of the compass (par. 65*c*).

82. Damp-Inducted Compass Reassembly and Installation

a. Reassembly.

(1) Position the compass needle lifter (9, fig. 42) and install the screw (11). Carefully place the compass needle (8) on the base pivot (10). Position the compass needle bumper block in the compass cover tube (1) and install the screw (2).

(2) Position the lever cam (7) in the compass cover tube (1) from inside of tube, with the flat side of the cam in a horizontal position. Place the compass lever tension spring (3) over the end of the lever cam (7) on the outside of the compass cover tube (1). Position the compass lever (4) over the compass lever tension spring (3) in a vertical position. Install the compass lever screw (5). Install the lever stop setscrew (14).

(3) Position the compass cover tube (10) over the compass base (10) and install the four compass cover tube screws (15). Move the compass lever (4) to the horizontal position.

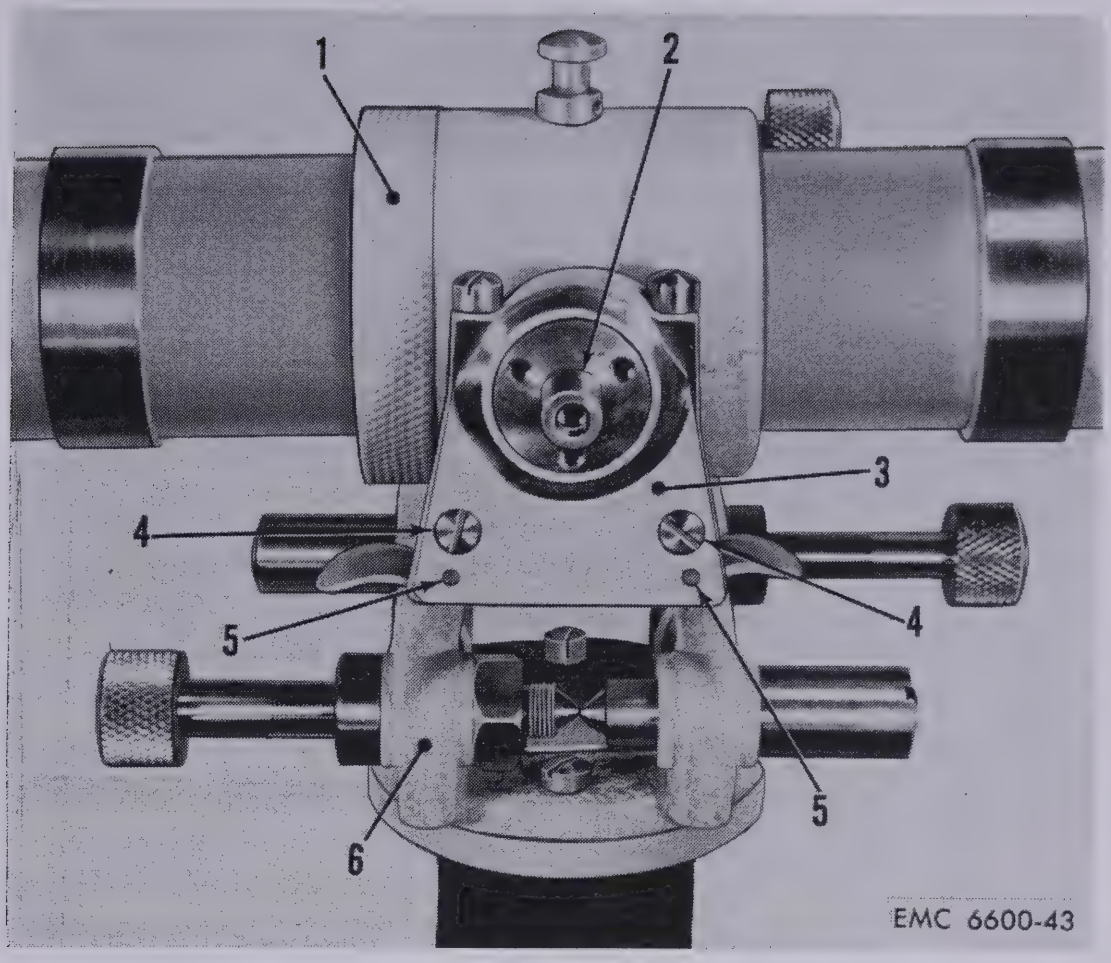
b. Installation. Install the damp-inducted compass on the base plate (par. 48*d*).

c. Compass Care and Handling. Balance the compass needle and handle the compass according to paragraph 67.

Section IX. VERNIER ASSEMBLY, MODEL P5093A

83. Description

The vernier assembly on the model P5093A alidade operates the same as that on the model 5093A with the exception of the vernier arc mounting. The vernier arc on the model 5093A swings on the bearing surface of the telescope axle. The vernier arc on the P5093A



1 Telescope lock ring
2 Telescope axle
3 Vernier arc bearing bracket
4 Bearing bracket screw (2 rqr)
5 Bearing bracket studs
6 Standard

Figure 43. Bearing bracket removal points, model P5093A.

model swings on the bearing surface of a bearing bracket (3, fig. 43) mounted on the standard (6).

84. Vernier Assembly Removal and Disassembly

a. Removal.

(1) Remove the telescope (par. 45*b*).
(2) Remove the magnifier (par. 46*b*).
(3) Remove the control lever (par. 46*b* or 47*b*).
(4) Remove the vertical arc assembly (par. 69*a*).

b. Disassembly.

(1) Disassemble the vernier assembly (par. 69*b*).
(2) Remove the two screws (4, fig. 43) and lift the bearing bracket (3) off the telescope axle (2) and standard (6).

85. Vernier Assembly Cleaning, Inspection, and Repair

a. Cleaning. Clean all parts of the vernier assembly (par. 70*a*). Clean the bearing bracket (3, fig. 43) and screws (4) with approved cleaning solvent.

b. Inspection. Inspect all parts of the vernier assembly for wear and damage (par. 70*b*). Check the bearing bracket (3, fig. 43) for cracks, bends, burs, and damaged studs. Inspect for worn or damaged bearing surface.

c. Repair. Repair all parts of the vernier assembly (par. 70*c*). Smooth out minor burs on the bearing bracket (3, fig. 43) and studs (5). Replace damaged bearing bracket and screws.

Note. If the bearing surface on the bearing bracket is damaged and the bracket has to be replaced, the entire vernier assembly will have to be replaced also. This is necessary as most parts in the vernier assembly are hand-fitted.

86. Vernier Assembly Reassembly and Installation

a. Reassembly.

(1) Position the bearing bracket (3) over the telescope axle (2) and on the standard (6) with the studs (5) in their mounting holes on the standard. Do not force the bearing bracket on the standard. Install the two screws (4).

(2) Reassemble the vernier assembly (par. 71*a*).

b. Installation.

(1) Install the vertical arc tangent thumbscrew assembly (par. 71*a*).

(2) Install the control level (par. 46*d* and 47*d*).

(3) Install the magnifier (par. 46*d*).

(4) Install the telescope (par. 45*d*).

Section X. STANDARD, PEDESTAL, AND BASE PLATE MODEL P5093A

87. Description

The standard, pedestal, and base plate, alidade model P5093A, function the same as the similar components in models 5093A and 5187A. The only major difference between the models is the way the standard is secured to the pedestal.

88. Standard, Pedestal, and Base Plate Removal, Disassembly, Cleaning, Inspection, and Repair

a. Removal.

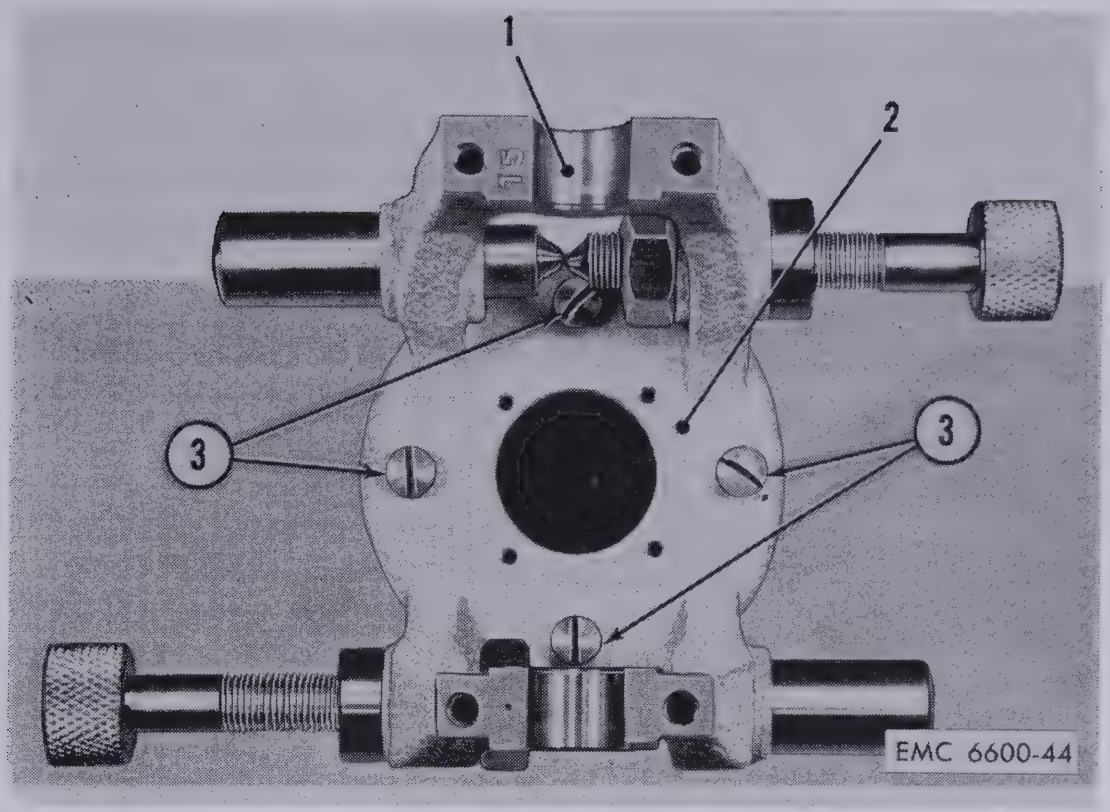
(1) Remove the telescope (par. 45*b*).

(2) Remove the magnifier (par. 46*b*).

(3) Remove the control level (par. 46*b* and 47*b*).

(4) Remove the vernier assembly (par. 84*b*).

(5) Remove the telescope axle assembly (par. 73).



1 Axle bearing 2 Standard 3 Screw (4 rqr)

Figure 44. Standard removal points, model P5093A.

b. Disassembly.

(1) Disassemble the standard, pedestal, and base plate (par. 73*b* (1)–(3)).

(2) Match-mark the standard (2, fig. 44), remove the four screws (3), and remove the standard (2) from the pedestal.

(3) Remove the pedestal from the base plate (par. 73*b* (4)).

c. Cleaning. Clean all parts of the standard, pedestal, and base plate (par. 74*a*).

d. Inspection. Inspect all parts of the assembly (par. 74*b*).

e. Repair. Repair all parts of the assembly (par. 74*c*).

89. Standard, Pedestal, and Base Plate Reassembly and Installation

a. Reassembly.

(1) Install the pedestal on the base plate (par. 75*a* (1)).

(2) Place the standard (2, fig. 44) on the pedestal, with the match marks and mounting holes alined. Install the four screws (3).

(3) Install the rest of the standard components (par. 75*a* (1)).

b. Installation.

(1) Install telescope axle assembly (par. 73*b*).

(2) Install the vernier assembly (par. 69*d*).

(3) Install the vertical arc tangent thumbscrew assembly (par. 69*c*).

(4) Install the control level (par. 46*d* and 47*d*).

(5) Install the magnifier (par. 46*d*).

(6) Install the telescope (par. 45*d*).

Section XI. TELESCOPE ASSEMBLY, MODELS 5095A, 5189A, AND P5095A

90. Description

The telescope assembly is composed of the same parts and operates the same as the one described in paragraph 58, with the exception of the prism assembly. The prism assembly on models 5095A, 5189A, and P5095A is mounted on the eyepiece end of the telescope, of which it is an intgeral part, and is not removed except to clean and service it.

91. Telescope Assembly Removal, Disassembly, Cleaning, Inspection, and Repair

a. Removal.

(1) Remove the telescope from the alidade (par. 45*b*).

(2) Slide the telescope lock ring (2, fig. 45) from the objective end of the telescope body (3).

b. Disassembly.

(1) Remove the eyepiece focusing ring lock screw (6) and separate the eyepiece focusing ring (11) and prism assembly from the eyepiece cell (14). Remove the two prism mount flange holder screws (13) and lift out the prism mount spring (12). Remove the eyepiece prism mount (9) and eyepiece prism flange (10) from the eyepiece focusing ring (11). Separate the eyepiece prism (7) and shims (8), if present, from the eyepiece prism mount (9).

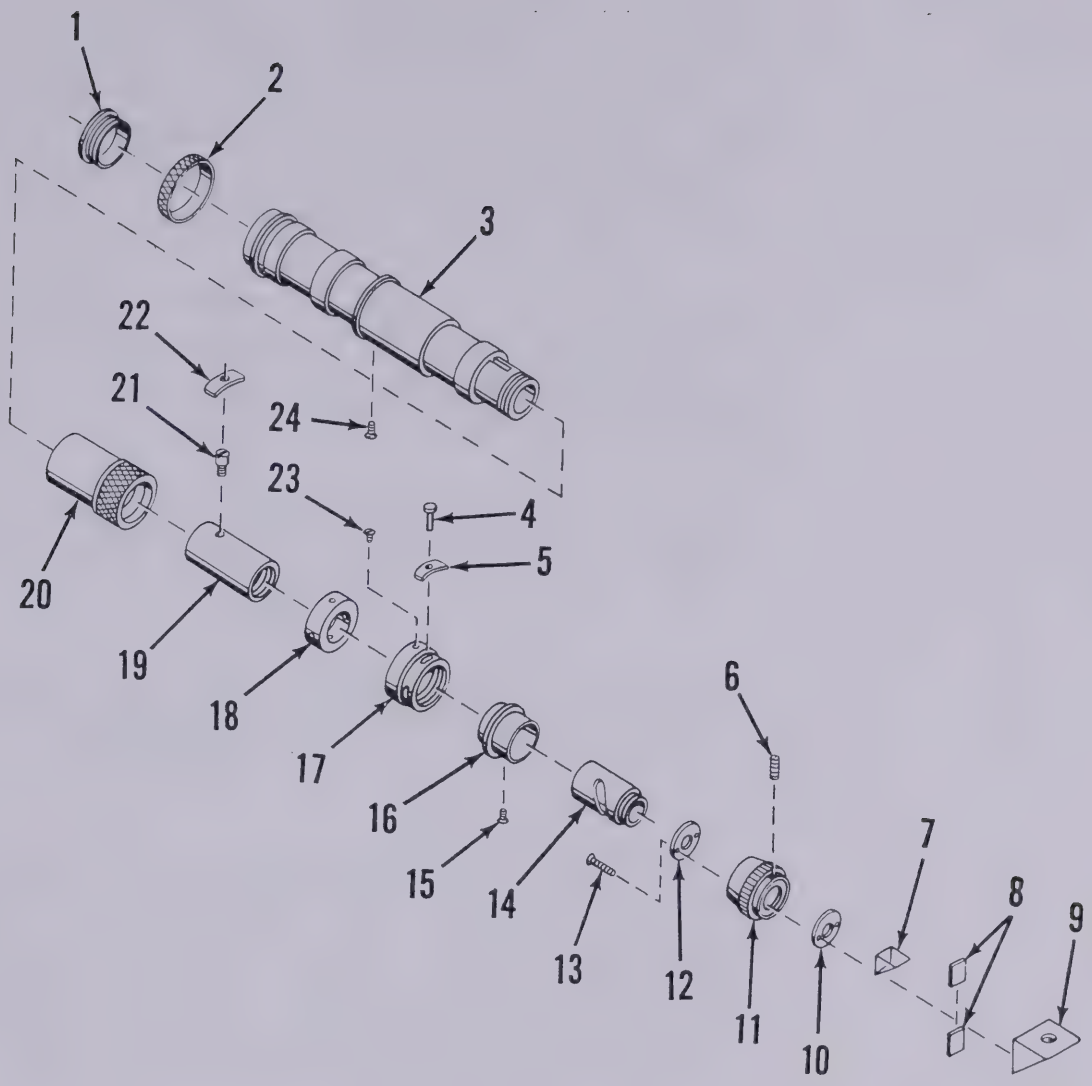
(2) For disassembly of the rest of the telescope, refer to paragraph 59*b*.

c. Cleaning. To clean the telescope assembly, see paragraph 60*a*.

d. Inspection. To inspect the telescope parts, see paragraph 60*b*.

e. Repair. To repair the telescope, see paragraph 60*c*.

f. Cross Wire Reticule. To clean, inspect, and repair the cross wire reticule (17, fig. 45), refer to paragraph 61.



EMC 6600-45

1	Objective lens assembly	13	Prism mount flange holder screw (2 rqr)
2	Telescope lock ring	14	Eyepiece cell
3	Telescope body	15	Eyepiece cam screw
4	Reticule adjusting screw 4 rqr)	16	Eyepiece sleeve
5	Reticule adjusting screw shutter (4 rqr)	17	Eyepiece body
6	Eyepiece focusing ring lock screw	18	Cross wire reticule
7	Eyepiece prism	19	Draw tube
8	Shim	20	Focusing lens cam
9	Eyepiece prism mount	21	Cam screw
10	Eyepiece prism flange	22	Cam shoe
11	Eyepiece focusing ring	23	Eyepiece body retaining screw
12	Prism mount screw	24	Telescope stop screw

Figure 45. Telescope assembly, models 5095A, 5189A, and P5095A, exploded view.

92. Telescope Assembly Reassembly and Installation

a. Reassembly.

(1) Reassemble the telescope, with the exception of the prism assembly (par. 62*a*).

(2) Install the shims (8, fig. 45) and eyepiece prism (7) in the eyepiece prism mount (9). Position the eyepiece prism

flange (10) on the eyepiece focusing ring (11) and aline the prism mount (9) assembly with the holes in the eyepiece prism flange (10). Position the prism mount spring (12) inside the eyepiece focusing ring (11) and aline the holes in the spring with those in the eyepiece prism flange (10). Install the two prism mount flange holder screws (13).

(3) Install the eyepiece focusing ring (11) and prism mount (9) assembly on the eyepiece cell (14) and aline the holes in the threaded end of the eyepiece cell mount and eyepiece focusing ring (11). Install the eyepiece focusing ring lock screw (6).

b. Installation. Slide the axle lock ring (2) over the objective lens end of the telescope body (3). Install the telescope on the alidade (par. 45*d*).

Section XII. VERNIER ASSEMBLY, MODELS 5095A, 5189A, AND P5095A

93. Description

The vernier assemblies have the same parts and function the same as the vernier assemblies previously covered. A gradienter screw assembly may be substituted for the vertical arc tangent thumbscrew (1, fig. 46) and the tangent thumbscrew bushing (2). The gradienter thumbscrew assembly, described in detail later on in this section, may be found on any of the miniature telescopic alidades.

94. Vernier Assembly Removal and Disassembly

a. Removal.

(1) Remove the telescope (par. 45*b*).

(2) Remove the magnifier (par. 46*b*).

(3) Remove the control level (par. 46*b* or 47*b*).

(4) Remove the vernier arc assembly (par. 69*a*).

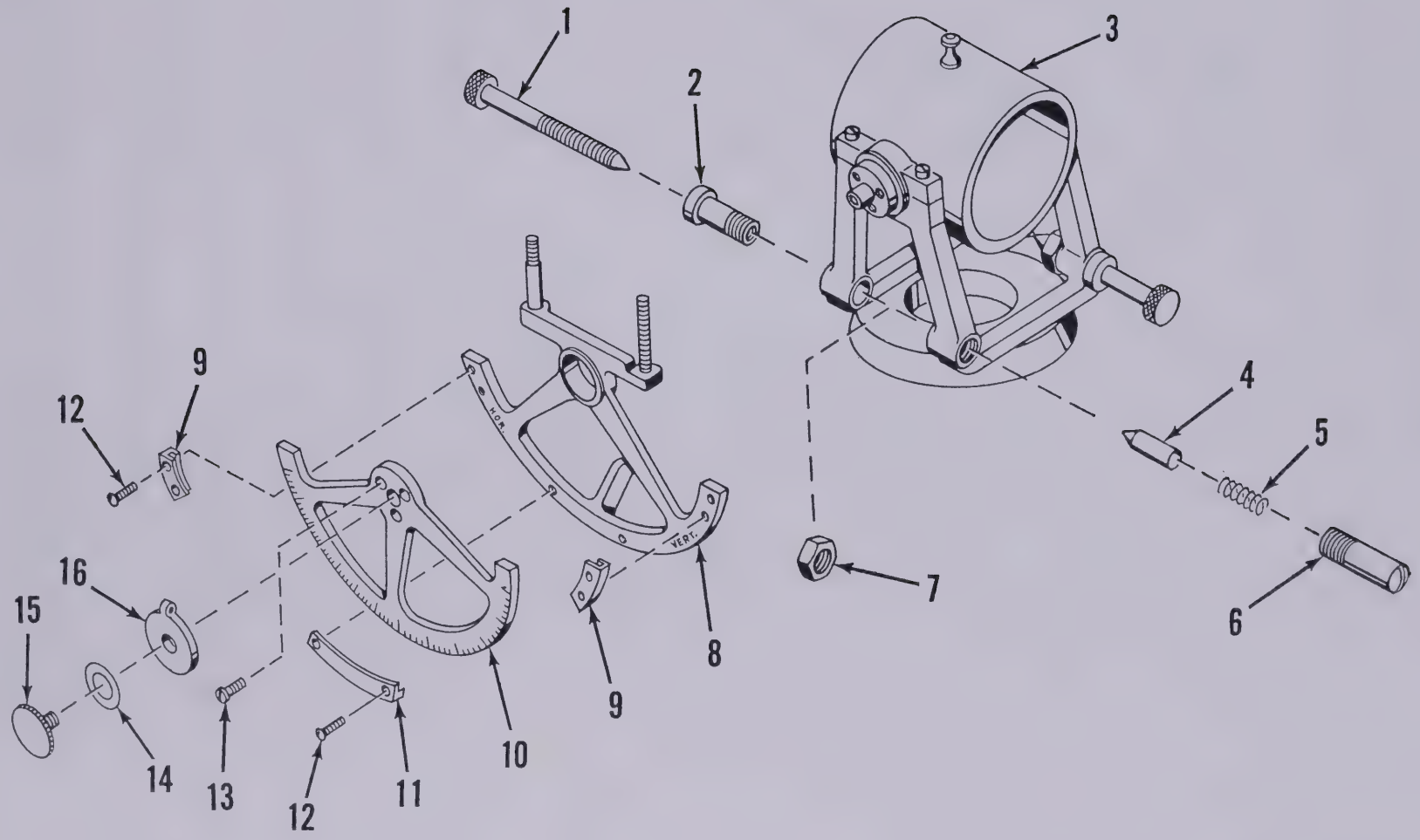
Note. If the vertical arc tangent thumbscrew (1, fig. 46) and tangent thumbscrew bushing (2) have been replaced by a gradienter screw assembly, remove the gradienter screw assembly (par. 94*a*(5)).

(5) Remove the hex nut (7, fig. 46). Remove the gradienter thumbscrew (1, fig. 47) assembly from the alidade. Remove the indicator screw (2) and remove the indicator (3) from the alidade standard.

b. Disassembly.

(1) Remove the gradienter thumbscrew bushing (5, fig. 47) from the gradienter thumbscrew (1).

(2) Remove the control dial lock plate (4) from the control dial (7) with a pair of needle nose pliers. Remove the lock

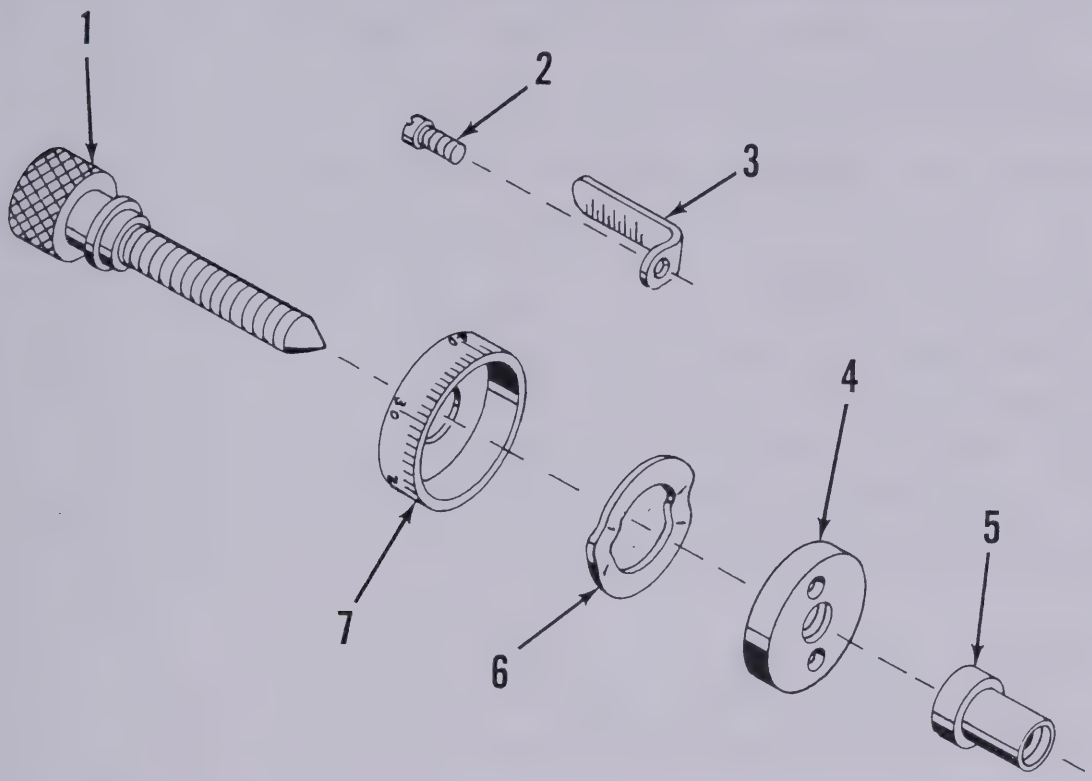


EMC 6600-46

Figure 46. Vernier assembly, models 5095A, 5189A, and P5095A, exploded view.

2 Tangent thumbscrew bushing
3 Alidade mounting standard
4 Tangent screw plunger
5 Tangent screw plunger spring
6 Tangent plunger housing
7 Nut, hex 3/8–32 x 1F–2
8 Vernier arc
10 Vertical arc
11 Vernier
12 Vernier and indice screw (6 rqr)
13 Vertical arc screw (3 rqr)
14 Axle spring washer
15 Telescope axle rozette
16 Magnifier holder

Figure 46—Continued.



EMC 6600-47

1 Gradienter thumbscrew
2 Indicator retaining screw
3 Indicator
4 Control dial lock plate
5 Gradienter thumbscrew bushing
6 Lock plate spring
7 Control dial

Figure 47. Gradienter screw assembly, exploded view.

plate spring (6) from the control dial (7). Remove the control dial (7) from the thumbscrew (1).

95. Vernier Assembly Cleaning, Inspection, and Repair

a. Cleaning.

(1) Clean all parts of the gradienter screw assembly with approved cleaning solvent.

(2) Clean all parts of the vernier assembly (par. 70*a*).

b. Inspection.

(1) Inspect the gradienter screw (1, fig. 47) and indicator screw (2) for burs and worn or damaged threads. Check the con-

trol dial (7) and control dial lock plate (4) for burs, damaged threads, cracks, and breaks. Inspect the lock plate spring (6) for damage and fatigue. Inspect the indicator (3) for bends and breaks.

(2) Inspect the parts of the vernier assembly (par. 70*b*).

c. Repair. Bend the lock plate spring to afford better tension. Replace gradienter screw assembly if any of the parts are defective.

Note. If the gradienter screw assembly is defective, and there is no replacement, a vertical arc tangent thumbscrew (9, fig. 36) assembly can be substituted.

96. Vernier Assembly Reassembly and Installation

a. Reassembly.

(1) Install the vernier assembly (par. 71*a*).

(2) Install the control dial (7) on the thumbscrew (1). Install the lock plate spring (6) on the thumbscrew (1) behind the control dial (7) and install the control dial lock plate (4). Tighten the lock plate with a pair of needle nose pliers.

(3) Install the gradienter thumbscrew (1) in the thumbscrew bushing (5). Install the gradienter thumbscrew assembly on the standard (3, fig. 46) and install the hex nut (7).

b. Installation.

(1) Install the control level (par. 46*d* or 47*d*).

(2) Install the magnifier (par. 46*d*).

(3) Install the telescope (par. 45*d*).

Section XIII. STANDARD AND BASE PLATE, MODELS 5095A, 5189A, AND P5095A

97. Description

The standard and base plate function the same as those described in paragraph 72. The only difference between the two is that the standard (13, fig. 48) is mounted directly on the base plate (16) in alidade models 5095A, 5189A, and P5095A, while in models 5093A, 5187A, and P5093A, the standard is installed on a pedestal which, in turn, is mounted on the base plate.

98. Standard and Base Plate Removal, Disassembly, Cleaning, Inspection, and Repair

a. Removal.

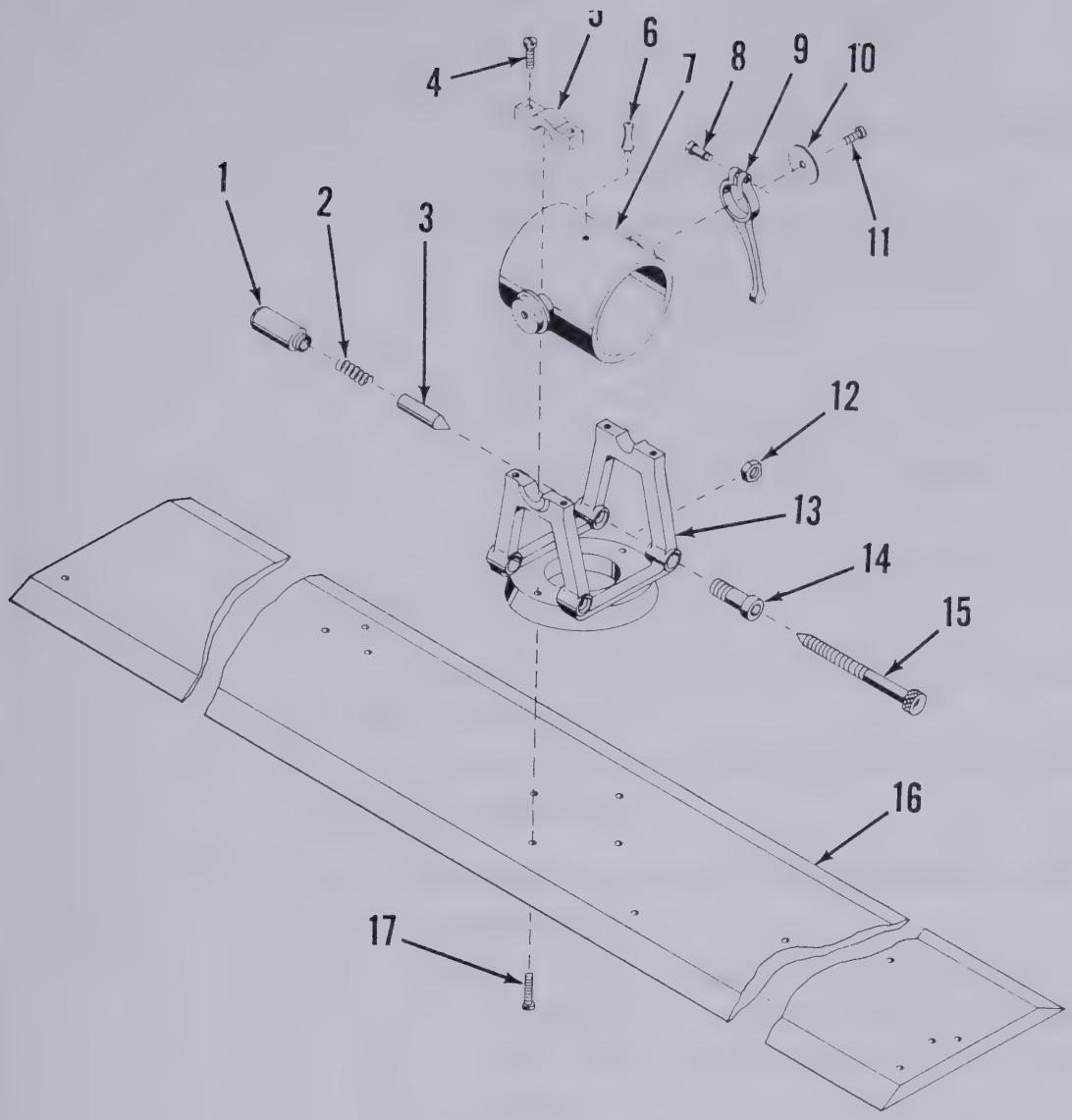
(1) Remove the telescope (par. 45*b*).

(2) Remove the magnifier (par. 46*b*).

(3) Remove the control level (par. 46*b* or 47*b*).

(4) Remove the vernier arc assembly.

(5) To remove the vernier arc plunger housing (1, fig. 48)



EMC 6600-48

1	Vernier arc plunger housing	10	Telescope clamp washer
2	Vernier arc plunger spring	11	Telescope clamp washer screw
3	Tangent screw plunger	12	Nut, hex, $\frac{3}{8}$–32 NF
4	Screw, br, fil hd, $\frac{7}{32}$ NF (4 rqr)	13	Standard
5	Standard cap (2 rqr)	14	Telescope tangent thumbscrew bushing
6	Striding level stud	15	Telescope tangent thumbscrew
7	Telescope axle	16	Base plate
8	Telescope clamp screw	17	Screw, br, flat hd, $\frac{5}{16}$ NF (4 rqr)
9	Telescope clamp		

Figure 48. Standard and base plate, models 5095A, 5189A, and P5095A, exploded view.

vernier arc plunger spring (2), tangent screw plunger (3), hex nut (12), telescope tangent bushing (14), and telescope tangent thumbscrew (15) from the standard (13), refer to paragraph 73*a*(6).

b. Disassembly.

(1) Remove the telescope clamp screw (8, fig. 48) from the telescope clamp (9). Remove the telescope clamp washer

screw (11) and lift off the telescope clamp washer (10) and telescope clamp (9).

(2) Remove the four screws (4) and lift off the two standard caps (5). Refer to *Note*, paragraph 73*b*.

(3) Lift the telescope axle (7) from the standard (13) and remove the striding level stud (6) from the axle.

(4) Match-mark the standard and base plate. Turn the alidade over and remove the four screws (17) from the underside of the base plate (16) and separate the base plate from the standard (13).

c. Cleaning. To clean the parts of the standard and base plate, refer to paragraph 74*a*.

d. Inspection. To inspect the parts of the standard and base plate, refer to paragraph 74*b*.

e. Repair. To repair the parts of the standard and base plate, refer to paragraph 74*c*.

99. Standard and Base Plate Reassembly and Installation

a. Reassembly.

(1) Invert the standard (13), place the base plate (16) on the standard base, alining the match marks and mounting holes, and install the four screws (17) in the bottom of the base plate.

(2) Install the striding level stud (6) in the telescope axle (7). Position the telescope axle (7) in the standard (13). Position the two standard caps (5), making sure that the match marks on the caps and the standard coincide, and install the four screws (4).

(3) Install the telescope clamp (9) and position the telescope clamp washer (10) on the telescope clamp washer screw (11) and install the telescope clamp washer screw (11) and clamp washer on the telescope. Install the telescope clamp screw (8) in the telescope clamp (9).

b. Installation.

(1) Install the gradienter tangent thumbscrew assembly (par. 96).

(2) Install the vernier arc assembly (par. 69*d*).

(3) Install the control level (par. 46*d* or 47*d*).

(4) Install the magnifier (par. 46*d*).

(5) Install the telescope (par. 45*d*).

(6) Install the base plate level (par. 48*d*).

(7) Install the trough compass (par. 48*d*).

CHAPTER 5
SHIPMENT, LIMITED STORAGE, AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

100. Limited Storage

a. General. Surveying instruments in storage must be protected against deterioration due to humidity and vibration. This manual is restricted to a discussion of storage in the limited sense. Storage of a longer or more permanent nature, such as storage in general engineer depots, is beyond the scope of this manual.

b. Storage in Unit Supply Rooms. In the case of special engineer units, such as construction units, the Tables of Organization and Equipment will include surveying materials which are used only occasionally. During periods of nonuse, the instruments will be stored in the supply room, instrument shop, or as directed by the unit commander. During such storage, surveying instruments should be inspected periodically, following the procedures given in paragraph 8*c*. The frequency of inspections will be prescribed by the unit commander, taking into consideration such factors as—

(1) The physical condition of the storage area, including such considerations as weatherproofing, vibration, and security from tampering or pilferage.
(2) The anticipated length of the period of nonuse.
(3) Humidity and temperature conditions.

101. Domestic Shipment

a. Preparation.

(1) Perform the inspection and services listed in paragraph 8.
(2) Set the alidade in the position for fitting properly into the carrying case.
(3) Cover the alidade with waterproof paper.
(4) Make certain that the alidade and carrying case are dry. Use only dry packing materials. Add bags of desiccant if obtainable.
(5) Place the alidade in the carrying case in the proper position.

(6) Place a copy of the report of condition, based on inspection, in the carrying case with the alidade.

(7) Place all tools and spare parts in the proper places provided in the carrying case.

(8) Fill in the space between the alidade and carrying case with suitable packing material, such as shredded paper, to provide a cushioning effect, and prevent damage during shipment.

Caution: Never use excelsior for packing in a surveying instrument carrying case.

(9) Close and fasten the carrying case securely.

b. Crating. Follow the crating instructions given in paragraph 6*b* as closely as possible, with materials available. Build the wooden crate so there is a two-inch space between the crate and container for cushioning material.

c. Marking. Mark the wooden crate with the caution as indicated below. Follow the procedures prescribed in MIL–STD–129.

Caution: Delicate instrument— handle with care. This side up.

Section II. DEMOLITION TO PREVENT ENEMY USE

102. General

When the capture or the abandonment of the alidade to an enemy is imminent, the responsible unit commander makes the decision either to destroy the instrument or to render it inoperative. Based on this decision, orders are issued which cover the extent of destruction. Whatever method of demolition is employed, it is essential to destroy the same vital parts of all similar surveying instruments, and all corresponding repair parts.

103. Demolition

Using a hammer, bar, or similar tool, break all lenses, level vials, compass, blade, telescope tube, tube shaft bearings, and telescope standard. All survey party personnel and all personnel having custody of the instruments must receive thorough training in approved methods of destruction. Simulated destruction will be included in the training program. It must be emphasized in training that demolition operations are usually made necessary by critical situations, when time available for destruction is limited. For this reason it is necessary that instrumentmen and all others having custody of the instruments be thoroughly familiar with all methods of destruction and are able to carry them out without reference to this or any other manual.

APPENDIX I
REFERENCES

1. Accessory Equipment

TM 5–687	Inspection and Preventive Maintenance Services for Fire Protection Equipment and Appliances.
TM 9–1799	Ordnance Maintenance: Fire Extinguishers.

2. Dictionaries of Terms and Abbreviations

SR 320–5–1	Dictionary of United States Army Terms.
SR 320–50–1	Authorized Abbreviations.

3. Related Manuals

TM 5–232	Elements of Surveying.
TM 5–233	Construction Surveying.
TM 5–234	Topographic Surveying.
TM 5–235	Special Surveys.

4. Publication Indexes

DA Pam 108–1	Index of Army Motion Pictures, Television Recordings and Filmstrips.
DA Pam 310–1	Index of Administrative Publications.
DA Pam 310–2	Index of Blank Forms.
DA Pam 310–3	Index of Training Publications.
DA Pam 310–4	Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
DA Pam 310–5	Index of Graphic Training Aids and Devices.

5. Supply Manuals

ENG 6 700–01	Repair Equipment, Set No. 1, Instrument, Topographic Battalion.
ENG 7, 8 & 9 6600–1	Alidade: JAN–A–708: KEUFFEL AND ESSER Number P5095A (Engineer Stock No. 18–1396.400.519) (FSN 6675–382–9131), Numbers 5095A and 5189A (Engineer Stock No. 18–1396.

400.520) (FSN 6675–190–5266), Number P5093A (Engineer Stock No. 18–1396.700.500) (FSN 6675–19–5263), Numbers 5093A and 5187A (Engineer Stock No. 18–1396.700.500) (FSN 6675–190–5263).

6. Training

FM 5–25	Explosives and Demolitions.
FM 21–5	Military Training.
FM 21–6	Techniques of Military Instruction.
FM 21–30	Military Symbols.

APPENDIX II

PARTS LIST

Figure No.	Index No.	Federal supply class and item identification No.	Engineer stock No.		Manufacturer's part No.		Description	Quanti per un
			Code No.	Part No.	Code No.	Part No.		
							Parts applicable only to Models Number 5093A and 5187A are designated by the symbol (A).	
							Parts applicable only to Models Number 5095–A and 5189–A are designated by the symbol (B).	
							Parts applicable only to Model Number P5093A are designated by the symbol (C).	
							Parts applicable only to Model Number P5095–A are designated by the symbol (D).	
							Parts not designated by a symbol are applicable to all end items.	
2	1		312	G7292–67	312	G7292–67	CAP, dust, telescope objective lens—(A, C)	1
	2		312	G7292–68	312	G7292–68	SUNSHADE, telescope—(A, C)	1
3	1						SUNSHADE, telescope—(A, C)	1
5	1			6650–427–3260	312	G7293–71	CAP, dust, telescope objective lens—(B, D)	1
	2			6650–427–3261	312	G7293–72	SUNSHADE, telescope—(B, D)	1
9			312	G7292–106	312	G7292–106	CARRYING CASE, alidade, telescopic: hardwood; w/sling—(A, C) (consists of items 2, 11, and 12).	1
10	4		312	5097–54	312	5097–54	CARRYING CASE, alidade, telescopic: leather—(B, D).	1
	11		312	5097–54A	312	5097–54A	SLING, carrying case, bag and case—(B, D)	1

Figure No.	Index No.	Federal supply class and item identification No.	Engineer stock No.		Manufacturer's part No.		Description	Quantity per unit
			Code No.	Part No.	Code No.	Part No.		
15	1	----------	312	G7292–56	312	G7292–56	TUBE END, adjustable, striding level bubble—(A, C).	1
	2	----------	312	G7292–59	312	G7292–59	SCREW, machine: br; rd hd $\frac{3}{16}$ dia, $\frac{5}{64}$ H; No. 2–64 NF–2, $\frac{3}{32}$ L; $\frac{7}{64}$ L—(A, C).	4
			312	G7292–62AY	312	G7292–63AY	VIAL, level—(A, C)	1
	3	----------	-----	5210–353–3465	312	G7292–62	VIAL, level: graduated, 5.333 to 6.000 minute range; clear liquid; grd; 80-mm + 0.000 — 2.0 L, 13-mm dia—(A, C).	1
	4	----------	312	G7292–54	312	G7292–54	NUT, plain, round: br; No. 10–36 NS–3; $\frac{7}{16}$ OD, 0.156 T—(A, C).	3
	5	----------	312	G7292–60	312	G7292–60	TUBE, level vial—(A, C)	1
	6	----------	312	G7292–61	312	G7292–61	COVER, level vial—(A, C)	1
	7	----------	312	G7292–58	312	G7292–58	TUBE END, fixed, striding level bubble—(A, C).	1
	8	----------	312	G7292–57	312	G7292–57	SCREW, machine: adjg; striding level bubble end—(A, C).	2
	9	----------	312	G7292–55	312	G7292–55	NUT, plain, round: br; No. 10–36 NS–2; $\frac{7}{16}$ OD, ¼ T—(A, C).	1
	10	----------	312	G7292–63	312	G7292–63	BRACKET, striding level—(A, C)	1
				6675–353–3460	312	G7292–53AY	LEVEL ASSEMBLY—(A, C)	1
	11	----------	312	G7292–64C	312	G7292–64C	SCREW, lock, striding level—(A, C)	1
	12	----------	312	G7292–64A	312	G7292–64A	SPRING, helical, compression: plgr screw—(A, C).	1
	13	----------	-----	5305–427–3227	312	G7292–64	SCREW, bubble bracket plunger: w/nut—(A, C).	1
	14	----------	312	G7292–64B	312	G7292–64B	SETSCREW: plgr sprg—(A, C)	1

18							LEVEL ASSEMBLY, alidade control
	1						TUBE END, adjustable
	2			6675–353–3444	312	G7292–16	VIAL, level: ctl; alidade
	3						NUT, rocker
	4						TUBE, level vial
	5						COVER, level vial
	6						WASHER, rocker
	7		312	G7292–13	312	G7292–13	ARC, vernier
	8		312	G7293–27	312	G7293–27	SCREW, machine: magnifier
	9		312	G7293–26	312	G7293–26	MAGNIFIER, telescope indice
21	1						TUBE END, fixed
	2			6675–353–3444	312	G7292–16	VIAL, level: ctl; alidade
	3						SPRING, fixed end
	4						SCREW, fixed end
	5						SCREW, adjustable end
	6						COVER, level vial
	7						TUBE END, adjustable
	8						PIN, tube end disk
	9						SCREW, disk pin, tube end
	10						TUBE, level vial
	11						ARC, vernier
	12						WASHER
22	1		312	G7292–27	312	G7292–27	KNOB: base plt—(A, C)
	2						COMPASS, trough
	3		312	G7292–6	312	G7292–6	SCREW, machine: br; fil hd $\frac{3}{16}$ dia, $\frac{1}{8}$ H; No. 4–48 NF–2, $\frac{9}{32}$ L (IMO 5)—(A, C).
	4		312	G7292–5	312	G7292–5	LEVEL, alidade base plate—(A, C)
	5		312	P5093A1	312	P5093A–1	PLATE, base, alidade—(C)
	7						VIAL, level
	9		312	G7292–51	312	G7292–51	SCREW, machine: br; flat cs hd $\frac{3}{16}$ dia; No. 4–48 NF–2, $\frac{11}{32}$ L; $\frac{3}{8}$ L.

Figure No.	Index No.	Federal supply class and item identification No.	Engineer stock No.		Manufacturer's part No.		Description	Quantity per unit
			Code No.	Part No.	Code No.	Part No.		
23				6675-427-3257	312	G7293-57AY	LEVEL ASSEMBLY, striding—(B, D)	1
	1		312	G7293-61	312	G7293-61	TUBE END, fixed, striding level bubble—(B, D).	1
	2		312	G7292-54	312	G7292-54	NUT, plain, round: br; No. 10-36 NS-3; $\frac{7}{16}$ OD, 0.156 T—(B, D).	3
	3		312	G7292-57	312	G7292-57	SCREW, winding	2
				6675-353-3473	312	G7293-61AY	VIAL ASSEMBLY, striding level—(B, D)	1
	4		312	G7293-68	312	G7293-68	COVER, level vial	1
	5			6675-353-3474	312	G7293-69	VIAL, level: graduated, 3 to 3.333 minute range; clear liquid; grd; 48-mm + 0.000 — 2.0L, 13-mm min 13¾mm max dia—(B, D).	1
	6			G7293-67	312	G7293-67	TUBE, level vial	1
	7		312	G7293-62	312	G7293-62	TUBE END, adjustable, striding level bubble—(B, D).	1
	8		312	G7292-55	312	G7292-55	NUT, plain, round, br; No. 10-36 NS-2; $\frac{7}{16}$ OD, ¼ T—(B, D).	1
	9		312	G7292-64C	312	G7292-64C	SCREW, lock, striding level—(B, D)	1
	10		312	G7293-64A	312	G7293-64A	SPRING, plunger screw—(B, D)	1
	11						SCREW AND COLLAR, bubble bracket plunger—(B, D).	1
	13		312	G7293-57	312	G7293-57	BRACKET, striding level—(B, D)	1
	14		312	G7292-64B	312	G7292-64B	SETSCREW: plgr sprg—(B, D)	1
	15		312	G7292-59	312	G7292-59	SCREW, machine: br; rd hd $\frac{3}{16}$ dia, $\frac{5}{64}$ H; No. 2-64 NF-2, $\frac{3}{32}$ L; $\frac{7}{64}$ L—(B, D).	4
24	1						COMPASS, trough	1

	2	----------	312	G7293-93	-----	----------	STUD, striding level	1
	3	----------	-----	----------	-----	----------	SCREW, striding level stop	2
4 and 9	----	----------	-----	6675-353-3472	312	G7293-5	LEVEL, circular, w/level vial—(B, D)	1
	5	----------	312	G7293-6	312	G7293-6	SCREW, machine: circular level—(B, D)	3
	6	----------	312	G7293-28	312	G7293-28	KNOB: base plt—(B, D)	2
	11	----------	312	G7292-51	312	G7292-51	SCREW, machine: br; flat cs hd $\frac{3}{16}$ dia; No. 4-48 NF-2, $\frac{11}{32}$ L; $\frac{3}{8}$ L.	2
27	1	----------	312	G7292-69AY	312	G7292-69AY	LENS, telescope objective: w/nut—(A, C)	1
	2	----------	312	G7292-69A	312	G7292-69A	MOUNT, telescope objective lens—(A, C)	1
	3	----------	312	G7292-66	312	G7292-66	RING, telescope lock—(A, C)	1
	4	----------	312	G7292-72	312	G7292-72	BODY, telescope—(A, C)	1
	5	----------	312	G7292-104	-----	----------	SCREW, telescope stop—(A, C)	1
	6	----------	312	G7292-100	-----	----------	CAP, eyepiece—(A, C)	1
	7	----------	312	G7292-97	312	G7292-97	RING, focusing, eyepiece—(A, C)	1
	8	----------	312	G7292-98A	312	G7292-98A	CELL, eyepiece mount—(A, C)	1
	9	----------	312	G7292-90	312	G7292-90	SLEEVE, eyepiece—(A, C)	1
	10	----------	312	G7292-86	312	G7292-86	BODY, eyepiece—(A, C)	1
	11	----------	-----	6650-427-3247	312	G7292-89	SHUTTER, reticule adjusting screw—(A, C).	4
	12	----------	312	G7292-88	312	G7292-88	SCREW, eyepiece adjusting—(A, C)	4
	13	----------	312	G7292-98	-----	----------	SCREW, eyepiece body retaining—(A, C)	1
	14	----------	312	G7292-96	312	G7292-96	SCREW, machine: eyepiece cam—(A, C)	1
	15	----------	312	G7292-83	312	G7292-83	CAMSHOE, telescope focusing lens	1
	16	----------	312	G7292-85	312	G7292-85	CAM, telescope focusing lens—(A, C)	1
	17	----------	312	G7292-75	-----	----------	TUBE, draw	1
			312	G7292-87AY	312	G7292-87AY	RETICULE ASSEMBLY, telescope—(A, C)	1
	18	----------	312	G7292-87	312	G7292-87	RETICULE, cross wire	1
	19	----------	312	G7292-96	312	G7292-96	SCREW, machine: eyepiece cam—(A, C)	1
	20	----------	312	G7292-98	312	G7292-98	SCREW, machine: br; flat flsr hd ¼ dia, $\frac{3}{32}$ H; No. 4-48 NF-2, $\frac{5}{16}$ L; $\frac{5}{16}$ L—(A, C)	1

Figure No.	Index No.	Federal supply class and item identification No.	Engineer stock No.		Manufacturer's part No.		Description	Quantity per unit
			Code No.	Part No.	Code No.	Part No.		
27				6650–353–3468	312	G7292–99AY	PRISM ASSEMBLY, telescope eyepiece—(A, C).	1
	21		312	G7292–102	312	G7292–102	MOUNT, eyepiece prism—(A, C)	1
	22		312	G7292–101	312	G7292–101	PRISM, eyepiece—(A, C)	1
	23		312	G7292–102A	312	G7292–102A	FLANGE, prism, eyepiece—(A, C)	1
	24		312	G7293–99	312	G7293–99	RING, prism eyepiece focusing—(A, C)	1
	25						SPRING, prism mount	1
	26		312	G7292–102B	312	G7292–102B	SCREW, flange, prism mount holder—(A, C).	2
35			312	G7292–38DAY			TROUGH COMPASS ASSEMBLY (consisting of):	1
	1						COVER, compass	1
	2						SCREW, compass cover retaining	4
	3						COVER GLASS, compass	1
	4						NEEDLE, compass	1
	5						CONE, compass needle	1
	6						LIFTER, compass needle	1
	7						BASE, compass	1
	8						PIVOT, compass	1
	9						TROUGH, compass	1
	10						SCREW, lever stop	2
	11						LEVER, compass	1
	12						SCREW, compass lever	1
	13						SPRING, compass lever tension	1
	14						CAM, lever	1

	15					SCREW, needle lifter	1
	16					BALANCE, wire	1
36			6675–427–3209	312	G7292–10AY	VERNIER ASSEMBLY, telescope—(A, B)	
	1		312 G7292–25	312	G7292–25	ROSETTE, telescope axle	1
	2		312 G7292–25A	312	G7292–25A	WASHER, flat: axle sprg	1
	3		312 G7293–23	312	G7293–23	HOLDER, magnifier	1
	4		312 G7292–11	312	G7292–11	SCREW, machine: br; rd hd $\frac{5}{32}$ dia, $\frac{1}{16}$ H, No. 2–56 NF–2, $\frac{7}{32}$ L; $\frac{7}{32}$ L—(A, B).	6
	5		312 G7292–10	312	G7292–10	INDICE, vernier arc—(A, B)	2
6–7			312 G7292–24	312	G7292–24	ARC, vertical: w/screw—(A)	1
	8		312 G7292–13	312	G7292–13	ARC, vernier—(A, B)	1
	9		312 G7292–28	312	G7292–28	THUMBSCREW: tangent, telescope—(A, B).	2
	10		312	312	G7292–29	BUSHING, tangent thumbscrew—(A, B)	2
			312 G7292–31AY	312	G7292–31AY	PLUNGER, ASSEMBLY, tangent screw	2
	12		312 G7292–32	312	G7292–32	HOUSING, telescope plunger	2
	13		312 G7292–31A	312	G7292–31A	SPRING, helical, compression: tangent screw plgr.	2
	14		312 G7292–31	312	G7292–31	PLUNGER, tangent screw	2
	15		5310–222–7156	312	G7292–30	NUT, plain, hexagon: br; $\frac{3}{8}$–32 NEF–2; $\frac{1}{2}$ W, 0.218 o/a H.	2
	16		312 G7292–12	312	G7292–12	VERNIER, vertical—(A, B)	1
37	1		312 G7292–9	312	G7292–9	SCREW, machine: br; flsr hd $\frac{7}{32}$ dia, $\frac{5}{32}$ H; No. 6–40 NF–2, $\frac{7}{16}$ L; $\frac{7}{16}$ L.	4
			312 G7292–7AY	312	G7292–7AY	STANDARD, alidade mounting	1
	2		312 G7292–8	312	G7292–8	CAP, standard	2
	3		312 G7292–103	312	G7292–103	STUD, striding level—(A, C)	1
	4			312	G7292–65	AXLE, telescope	1
	5		312 G7292–35	312	G7292–35	SCREW, machine, telescope clamp	1
	6		312 G7292–33	312	G7292–33	CLAMP, alidade telescope	1

Figure No.	Index No.	Federal supply class and item identification No.	Engineer stock No.		Manufacturer's part No.		Description	Quantity per unit
			Code No.	Part No.	Code No.	Part No.		
37	7			5310–273–7676	312	G7292–34	WASHER, flat: rd; br; rd hole 0.1130 dia, 0.718 OD, 0.063 T.	1
	8		312	G7292–36	312	G7292–36	SCREW, machine: telescope clamp wshr	1
	12						STANDARD	1
	14		312	G7292–3	312	G7292–3	PEDESTAL, alidade—(A)	1
	15		312	G7292–1	312	G7292–1	PLATE, base, alidade—(A)	1
	16		312	G7292–4	312	G7292–4	SCREW, machine; br; flat hd dia, $\frac{3}{32}$ H; No. 10–32 NF–2, $\frac{5}{16}$ L; $\frac{11}{32}$ L—(A, C).	4
	19		312	G7292–7A	312	G7292–7A	SCREW, machine: br; flsr hd $\frac{7}{32}$ dia, $\frac{5}{32}$ H; No. 6–40 NF–2, $\frac{11}{32}$ L—(A).	2
	20		312	G7292–104	312	G7292–104	STOP, telescope, alidade	1
	21		312	G7292–105	312	G7292–105	SCREW, telescope stop	4
41	1		312	G7292–100			CAP, eyepiece	1
	2						RING, eyepiece focusing	1
	3		312	G7292–97			SCREW, eyepiece focusing ring retaining	1
	4						RING, eyepiece definition	1
	5		312	G7292–96			SCREW, eyepiece cam retaining	1
	6		312	G7292–98A			CELL, eyepiece	1
	7						SCREW, spiral guide	1
42				6675–353–3453	312	G7292–38DAY	COMPASS ASSEMBLY, damp inducted	1
	1		312	G7292–39D	312	G7292–39D	TUBE, compass cover	1
	2		312	G7292–52D			SCREW, bumper block retaining	1
	3		312				SPRING, tension lever, compass	1
	4		312	G7292–47D	312	G7292–47D	LEVER, compass	1
	5		312	G7292–48D	312	G7292–48D	SCREW, machine: br; flsr hd ¼ dia, $\frac{1}{16}$ H; No. 2–56 NC–2, ⅛ L; $\frac{5}{32}$ L.	1

	6		312	G7292–49D	312	G7292–49D	GLASS, trough compass	1
	7		312	G7292–46D	312	G7292–46D	CAM, lever	1
8 and 12				6675–353–3457	312	G7292–44DAY	NEEDLE, compass: w/cap and spring balance.	1
	9		312	G7292–41D	312	G7292–41D	LIFTER, compass needle	1
	10		312	G7292–38D	312	G7292–38D	BASE, compass, w/pivot	1
	11			5305–374–2339	312	G7292–40D	SCREW, compass pivot	1
	13						BLOCK, compass needle bumper	1
	14			5305–374–9860	312	G7292–52D	SETSCREW: lvr stop	1
	15		312	G7292–50D	312	G7292–50D	SCREW, machine: compass cover tube	4
43	3		312	A24604	312	A24604	BRACKET, vernier arc bearing bracket—(C, D).	1
	4		312	A24604–1	312	A24604–1	SCREW, bearing bracket	2
44	3		312	G7292–7A	312	G7292–7A	SCREW, machine: br; flsr hd $\frac{7}{32}$ dia, $\frac{5}{32}$ H; No. 6–40 NF–2, $\frac{11}{32}$ L, $\frac{11}{32}$ L—(C).	4
	4		312	P5093A3	312	P5093A–3	PEDESTAL, alidade	1
45	1		312	G7293–73AY	312	G7293–73AY	LENS, telescope objective: w/nut—(B, D)	1
	2		312	G7293–105	312	G7293–105	RING, telescope lock—(B, D)	1
	3		312	G7293–75	312	G7293–75	BODY, telescope—(B, D)	1
	4		312	G7292–88	312	G7292–88	SCREW, reticule adjusting	4
	5			6650–427–3247	312	G7292–89	SHUTTER, reticule adjusting screw—(B, D).	4
	6		312	G7293–100	312	G7293–100	SCREW, eyepiece focusing ring lock—(B, D).	1
	7		312	G7292–101	312	G7292–101	PRISM, eyepiece—(B, D)	1
	8						SHIM—(B, D)	2
	9		312	G7292–104	312	G7292–104	MOUNT, eyepiece prism—(B, D)	1
	10		312	G7292–102A	312	G7292–102A	FLANGE, prism eyepiece—(B, D)	1
	11		312	G7293–99	312	G7293–99	RING, eyepiece focusing—(B, D)	1
	12		312	G7292–102A	312	G7292–102A	FLANGE, prism mount	1

Figure No.	Index No.	Federal supply class and item identification No.	Engineer stock No.		Manufacturer's part No.		Description	Quantity per unit
			Code No.	Part No.	Code No.	Part No.		
45	13		312	G7292–102B	312	G7292–102B	SCREW, flange, prism mount holder—(B, D).	2
	14		312	G7292–98A	312	G7292–98A	MOUNT, eyepiece cell	1
	15		312	G7292–96	312	G7292–96	SCREW, machine: eyepiece cam—(B, D)	1
	16		312	G7292–90	312	G7292–90	SLEEVE, eyepiece—(B, D)	1
	17		312	G7292–88	312	G7292–88	BODY, alidade telescope—(B, D)	1
			312	G7293–89AY	312	G7293–89AY	RETICULE ASSEMBLY, telescope—(B, D)	1
	18		312	G7292–87	312	G7292–87	RETICULE, cross wire—(B, D)	1
	19		312	G7292–78	312	G7293–78	TUBE, draw	1
	20		312	G7293–81	312	G7293–81	LENS, focusing	1
	21		312	G7292–96	312	G7292–96	SCREW, machine: eyepiece cam—(B, D)	1
	22		312	G7292–83	312	G7292–83	CAMSHOE, telescope focusing lens	1
	23						SCREW, eyepiece body retaining	1
	24						SCREW, telescope stop	1
46			312	P5093A10AY	312	P5093A–10AY	VERNIER ASSEMBLY, telescope—(C, D)	1
	1		312	G7293–29	312	G7293–29	THUMBSCREW: telescope tangent—(C, D)	2
	2		312	G7293–30	312	G7293–30	BUSHING, tangent thumbscrew—(C, D)	2
	3		312	P5093A7AY	312	P5093A–7AY	STANDARD, alidade mounting—(C)	1
	3		312	P5095A7AY	312	P5095A–7AY	STANDARD, alidade mounting—(D)	1
	4		312	P7292–31	312	G7292–31	PLUNGER, tangent screw	2
	5		312	G7292–31A	312	G7292–31A	SPRING, helical, compression: tangent screw plgr.	2
	6		312	G7292–32	312	G7292–32	HOUSING, telescope plunger	2
	7			5310–222–7156	312	G7293–31	NUT, plain, hexagon: br; ⅜–32 NEF–2; ½ W 0.218 o/a H—(C, D).	2

	8		312	G7292–13	312	G7292–13	ARC, vernier—(C, D)	1
	9		312	G7292–10	312	G7292–10	INDICE, vernier arc—(C, D)	2
	10 and 13		312	P5093A24	312	P5093A–24	ARC, vertical: w/screws—(C, D)	1
	11		312	G7292–12	312	G7292–12	VERNIER, vertical—(C, D)	2
	12		312	G7292–11	312	G7292–11	SCREW, machine: br; rd hd; $\frac{5}{32}$ dia, $\frac{1}{16}$ H, No. 2–56 NC–2, $\frac{7}{32}$ L, $\frac{7}{32}$ L—(C, D).	6
	14		312	G7292–25A	312	G7292–25A	WASHER, flat: axle spring	1
	15		312	G7292–25	312	G7292–25	ROSETTE, telescope axle	1
	16		312	G7293–23	312	G7293–23	HOLDER, magnifier	1
47			312	G7293–38AY	312	G7293–38AY	GRADIENTER ASSEMBLY, telescope—(B, D).	1
	1		312	G7293–39	312	G7293–39	THUMBSCREW; dial—(B, D)	1
	2		312	G7293–41	312	G7293–41	SCREW, indicator retaining	1
	3		312	G7293–40	312	G7293–40	INDICATOR, azimuth-elevation-range—(B, D).	1
	4						PLATE, control dial lock—(B, D)	1
	5						BUSHING, gradienter thumbscrew	1
	6						SPRING, lock plate	1
	7		312	G7293–38	312	G7293–38	DIAL, control—(B, D)	1
48	4		312	G7292–9	312	G7292–9	SCREW, machine: br; flsr hd $\frac{7}{32}$ dia, $\frac{5}{32}$ H; No. 6–40 NF–2, $\frac{7}{16}$ L; $\frac{7}{16}$ L.	4
	5		312	G7293–3	312	G7293–3	CAP, standard	2
	6		312	G7293–33	312	G7293–33	STUD, striding level—(B, D)	1
	7		312	G7293–106	312	G7293–106	AXLE, telescope	1
	8		312	G7292–36	312	G7292–36	SCREW, machine: telescope clamp	1
	9		312	G7293–33	312	G7292–33	CLAMP, alidade telescope	1
	10			5310–273–7676	312	G7292–34	WASHER, flat: rd; br; rd hole 0.1130 dia, 0.718 OD, 0.063 T.	1

Figure No.	Index No.	Federal supply class and item identification No.	Engineer stock No.		Manufacturer's part No.		Description	Quantity
			Code No.	Part No.	Code No.	Part No.		
48	11		312	G7292–35	312	G7292–35	SCREW, machine: telescope clamp washer	1
	16		312	G7293–1	312	G7293–1	PLATE, base—(B)	1
	16		312	P5095A1	312	P5095A–1	PLATE, base—(D)	1
	17		312	G7293–2A	312	G7293–2A	SCREW, standard to base plate	4

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For explanation of abbreviations used, see SR 320–50–1.

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